DONORS

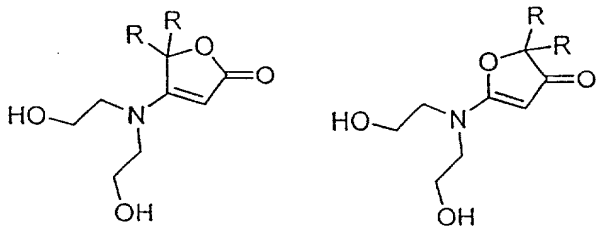
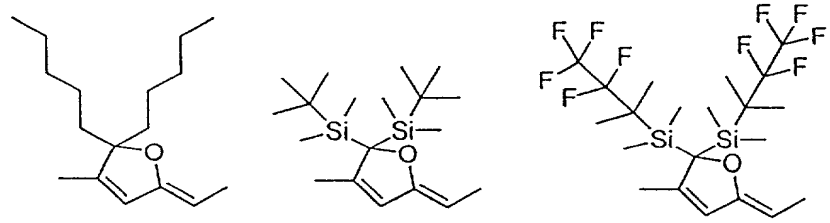


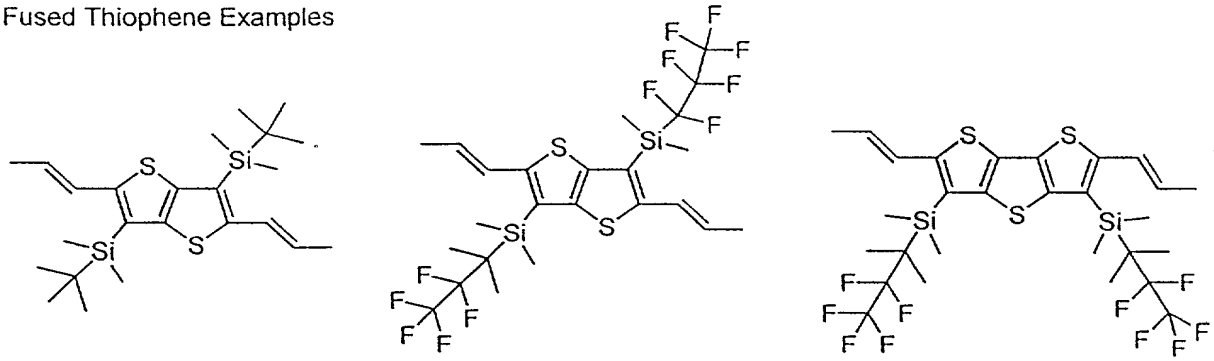
FIGURE 1

BRIDGES

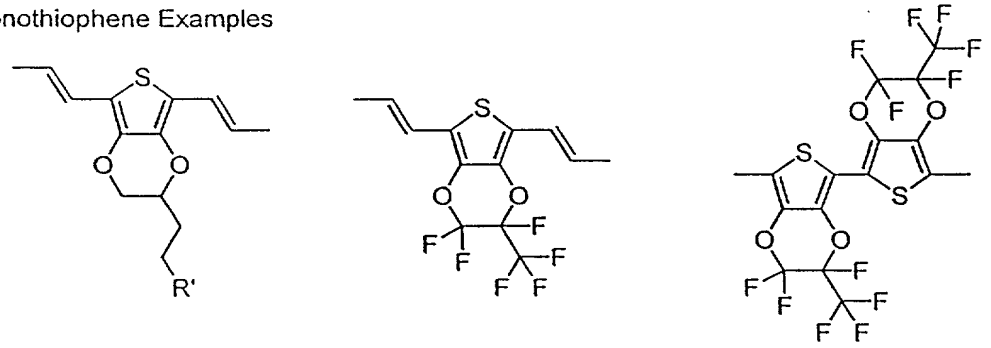
1. Polyene Examples



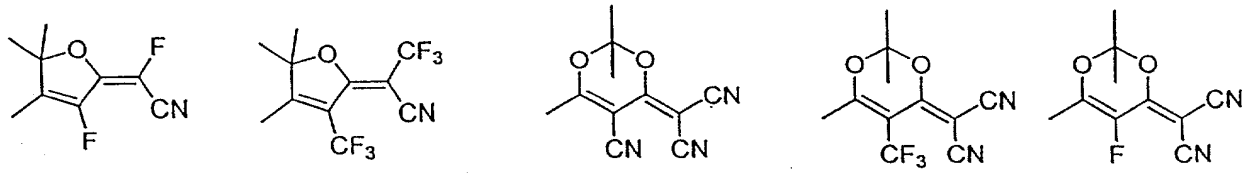
2. Fused Thiophene Examples



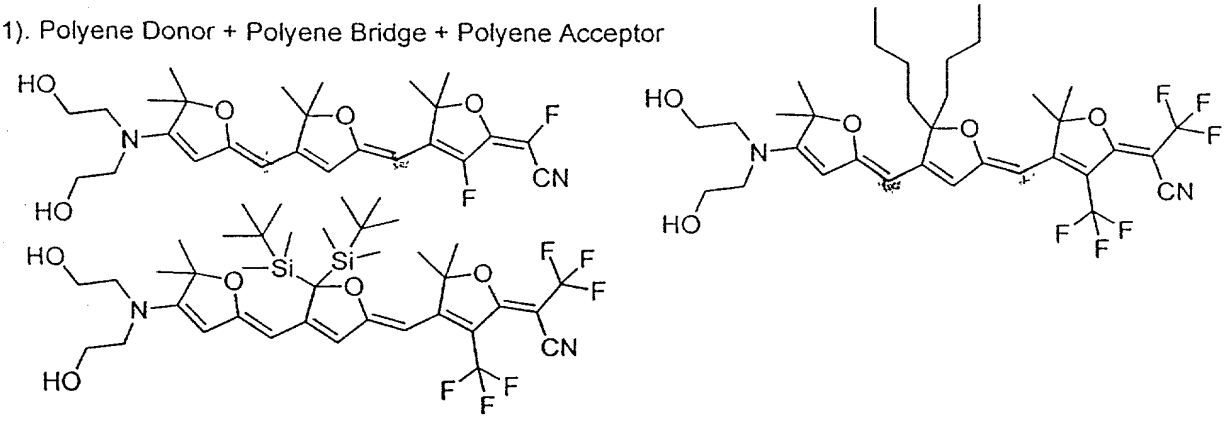
3. Monothiophene Examples



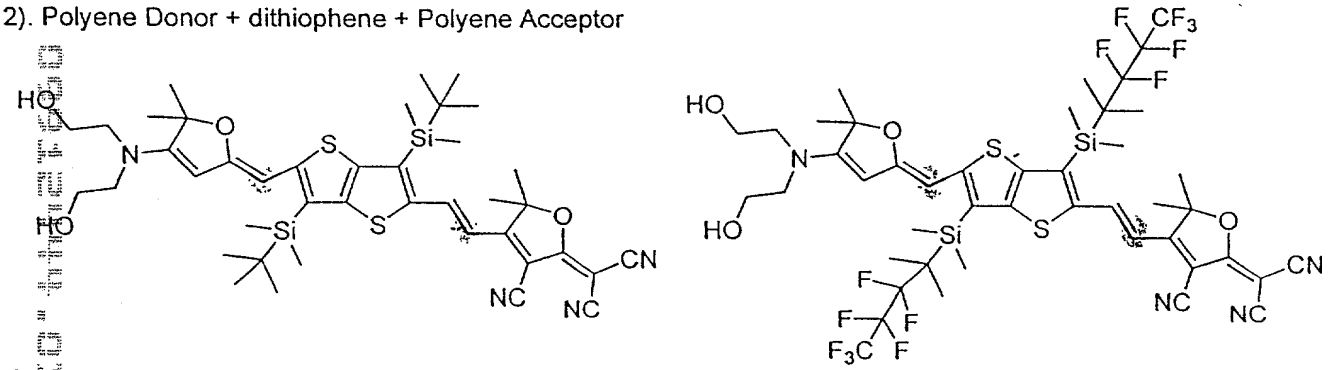
ACCEPTORS



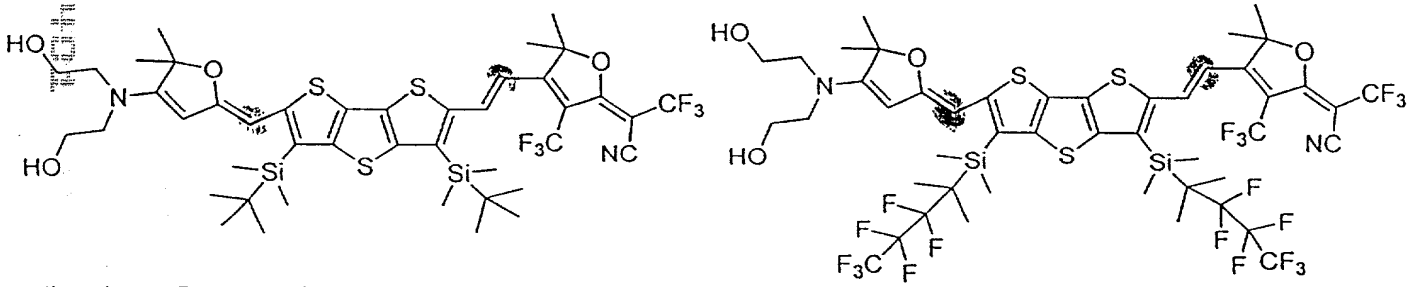
1). Polyene Donor + Polyene Bridge + Polyene Acceptor



2). Polyene Donor + dithiophene + Polyene Acceptor



3). Polyene Donor + tri-thiophene bridge + Polyene Acceptor



4). polyene Donor + thiophene + Polyene Acceptor

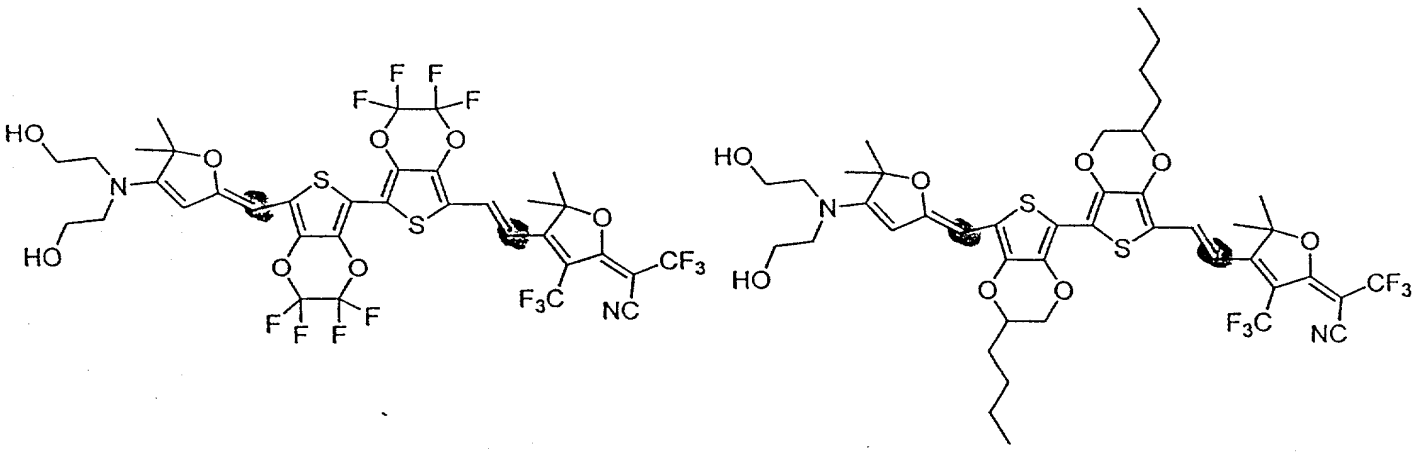
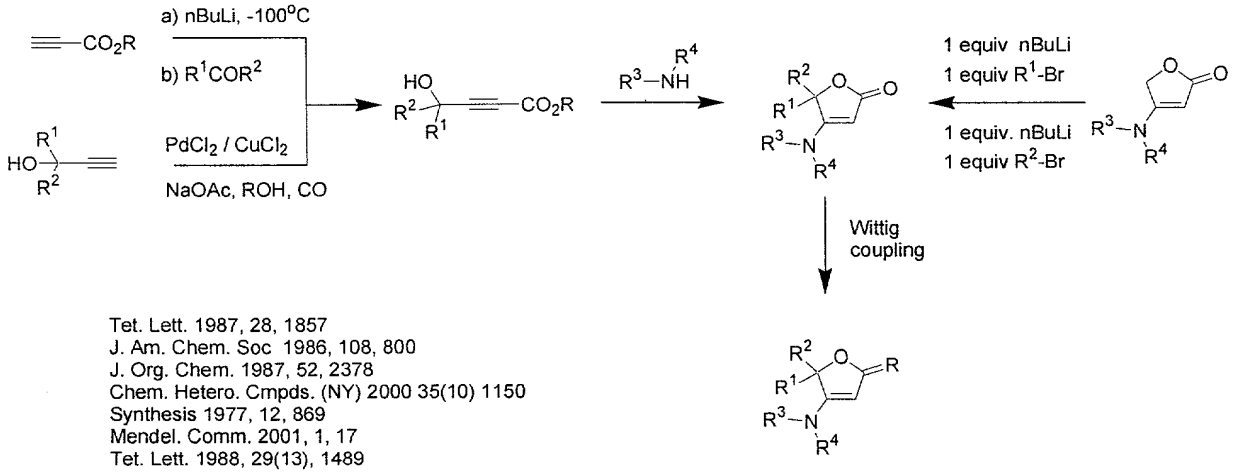


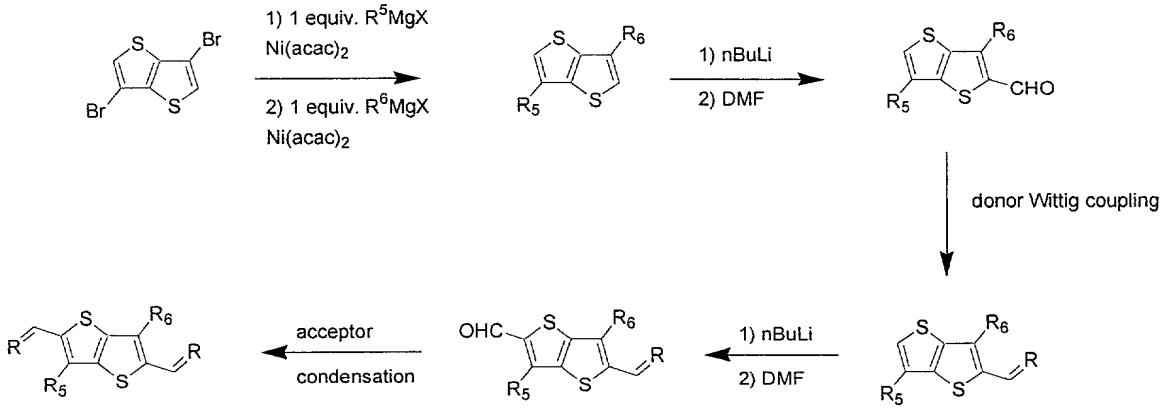
FIGURE 2

Title: HYPERPOLARIZABLE ORGANIC CHROMOPHORES
Inventors: L.R. Dalton et al.
Docket No.: UOFW117403



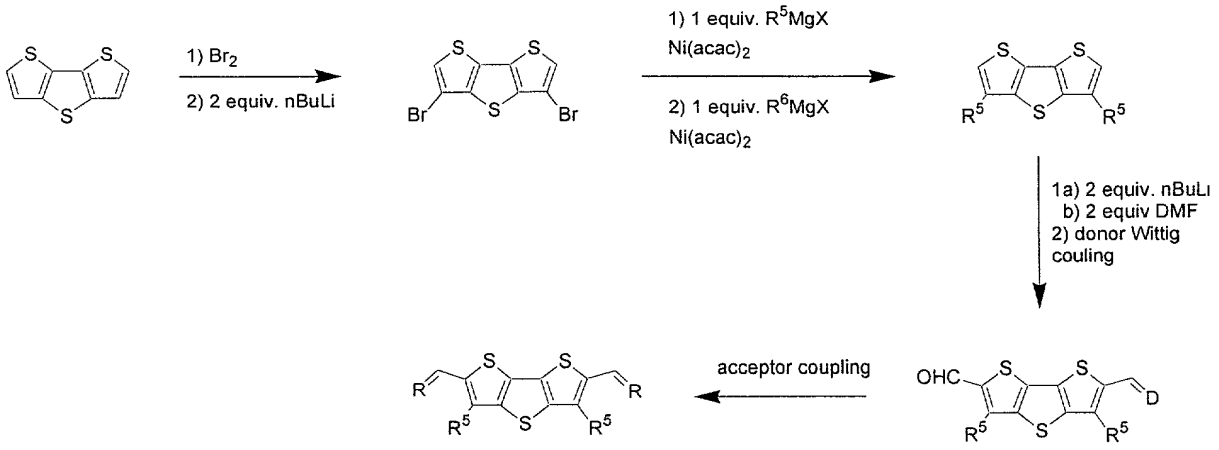
Tet. Lett. 1987, 28, 1857
J. Am. Chem. Soc 1986, 108, 800
J. Org. Chem. 1987, 52, 2378
Chem. Hetero. Cmpds. (NY) 2000 35(10) 1150
Synthesis 1977, 12, 869
Mendel. Comm. 2001, 1, 17
Tet. Lett. 1988, 29(13), 1489

FIGURE 3



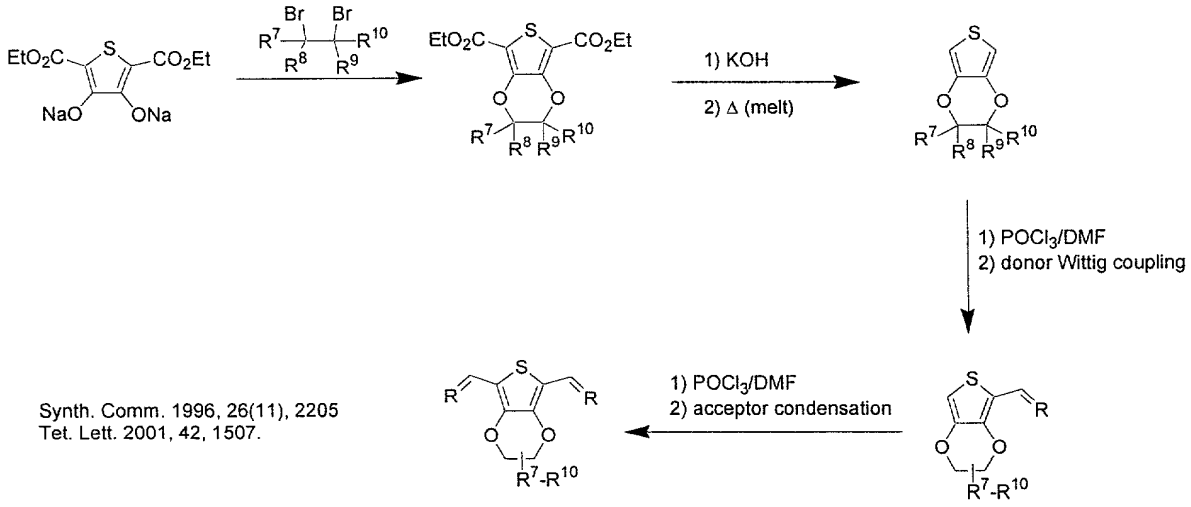
J. Chem. Soc. Perk. Trans. 1 1997, 22, 3465
Heterocycles 1994, 38(1), 143
J. Organomet. Chem. 1973, 50, C12
Pure Appl. Chem. 1980, 52, 669
Tet. Lett. 1981, 22, 4449

FIGURE 4



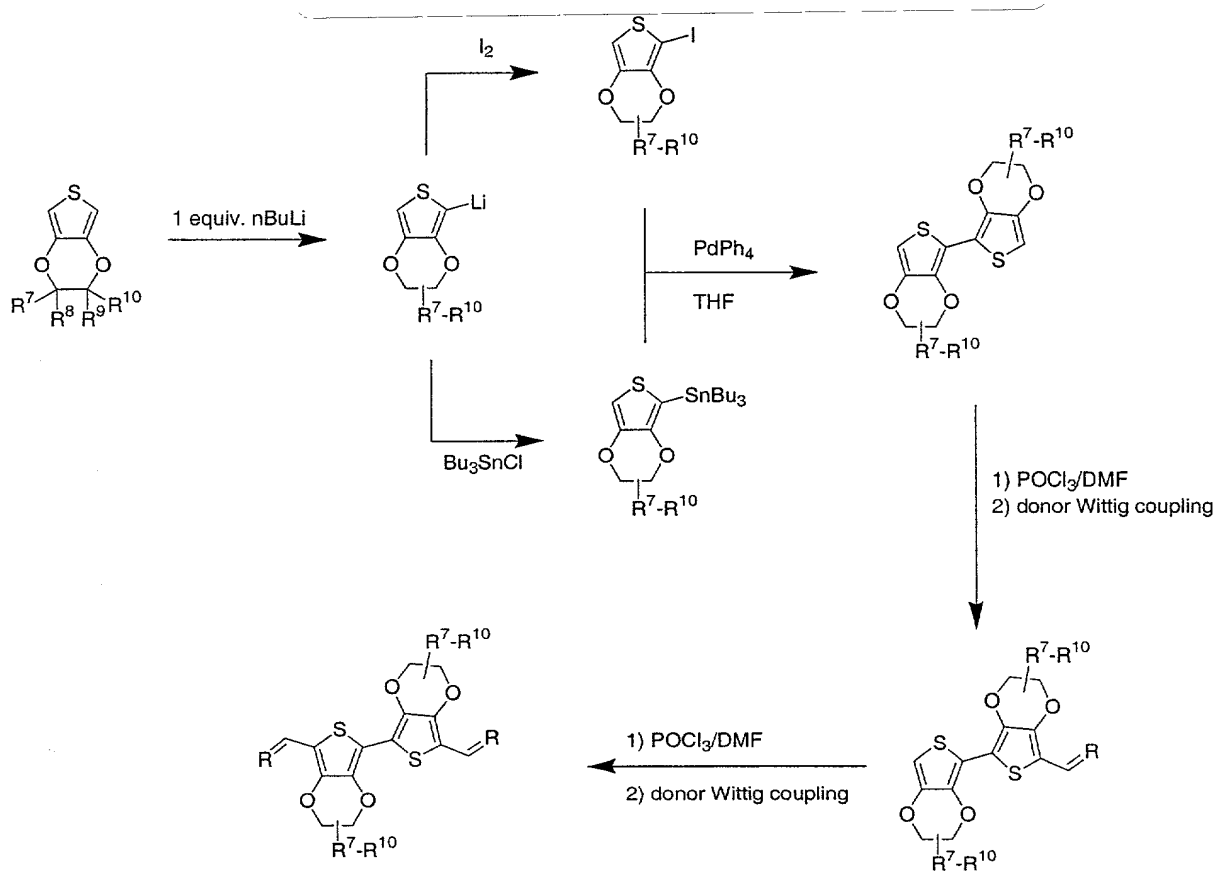
J Org. Chem. 1971, 36(12), 1645
J. Chem. Soc. Perk. Trans. 2 1992, 5, 765
J. Mater. Chem. 1999, 9(9), 2227

FIGURE 5



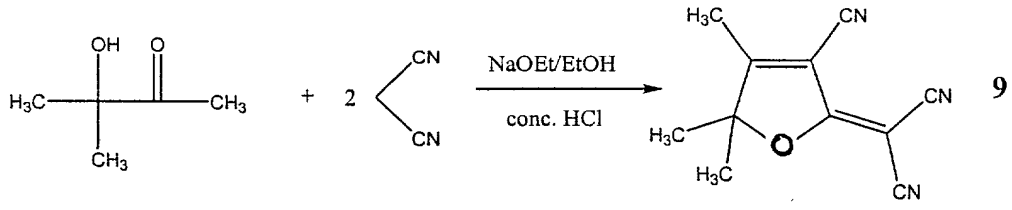
Synth. Comm. 1996, 26(11), 2205
Tet. Lett. 2001, 42, 1507.

FIGURE 6



J. Am. Chem. Soc. 2001, 123(19), 4643
Chem. Mater. 1996, 8(11), 2659
J. Chem. Soc. Perkins Trans. I 1997, 1957

FIGURE 7



9

FIGURE 11

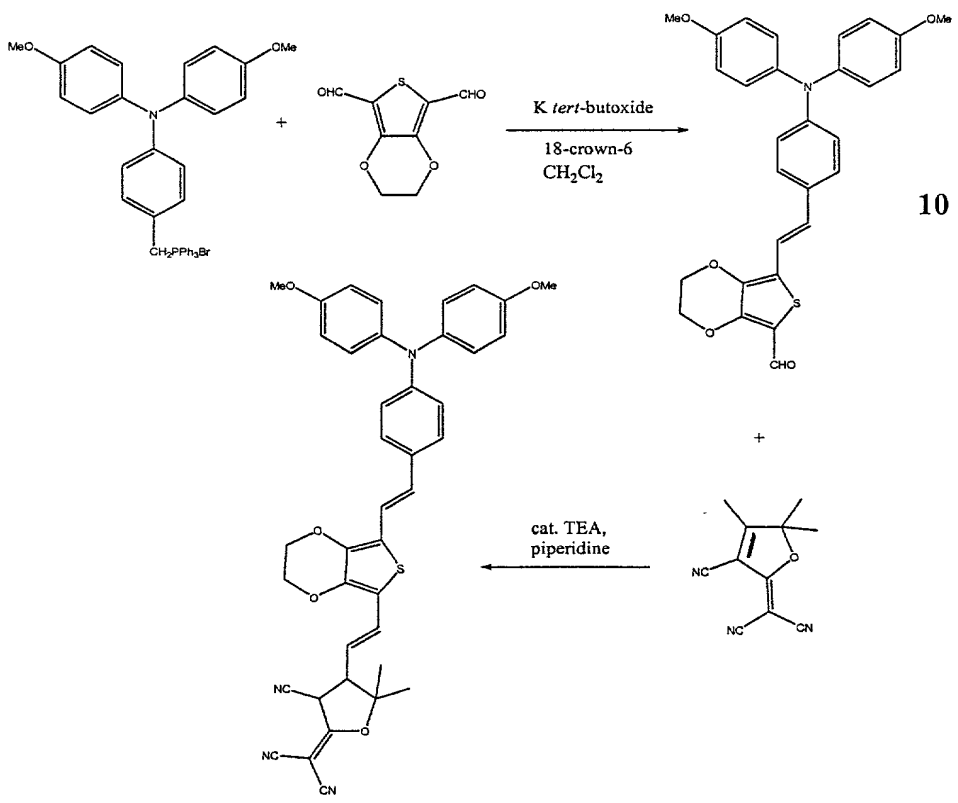


FIGURE 8

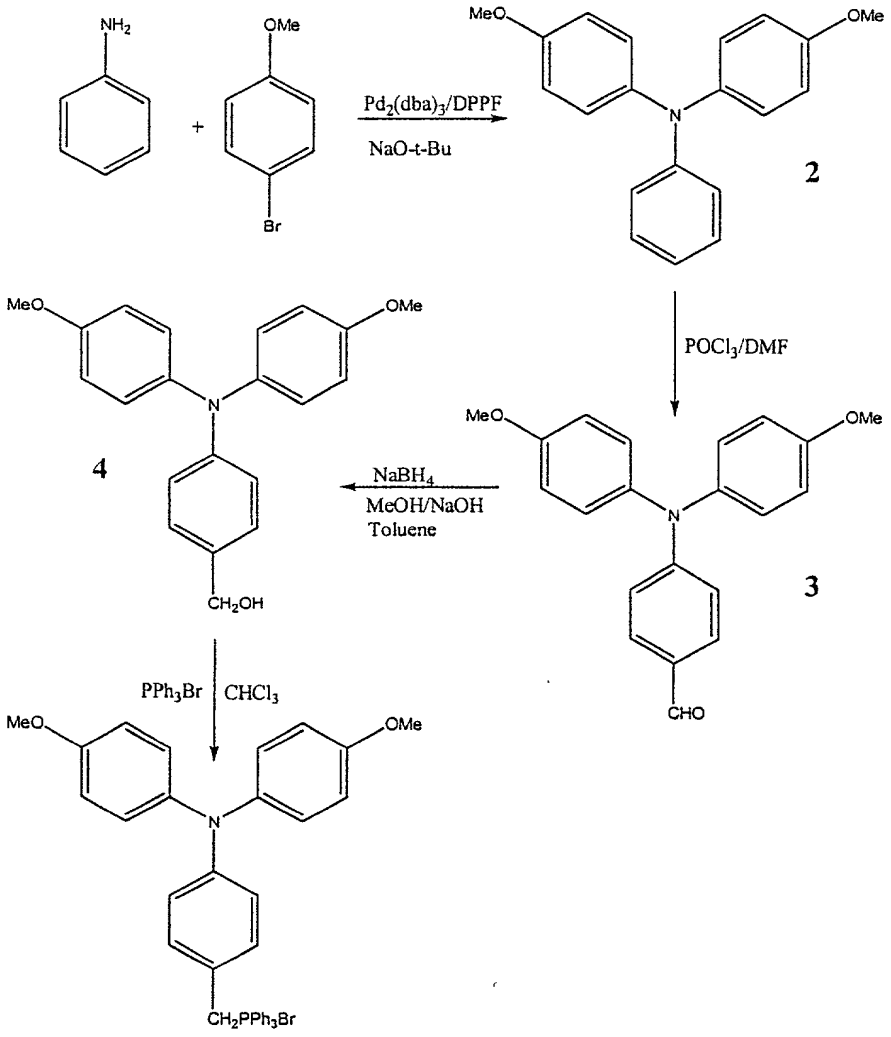

NH2
OMe
Br
Pd2(dba)3/DPPF
NaO-t-Bu
MeO
OMe
N
2
POCl3/DMF
3
CHO
NaBH4
MeOH/NaOH
Toluene
4
CH2OH
PPh3Br
CHCl3
CH2PPh3Br

FIGURE 9

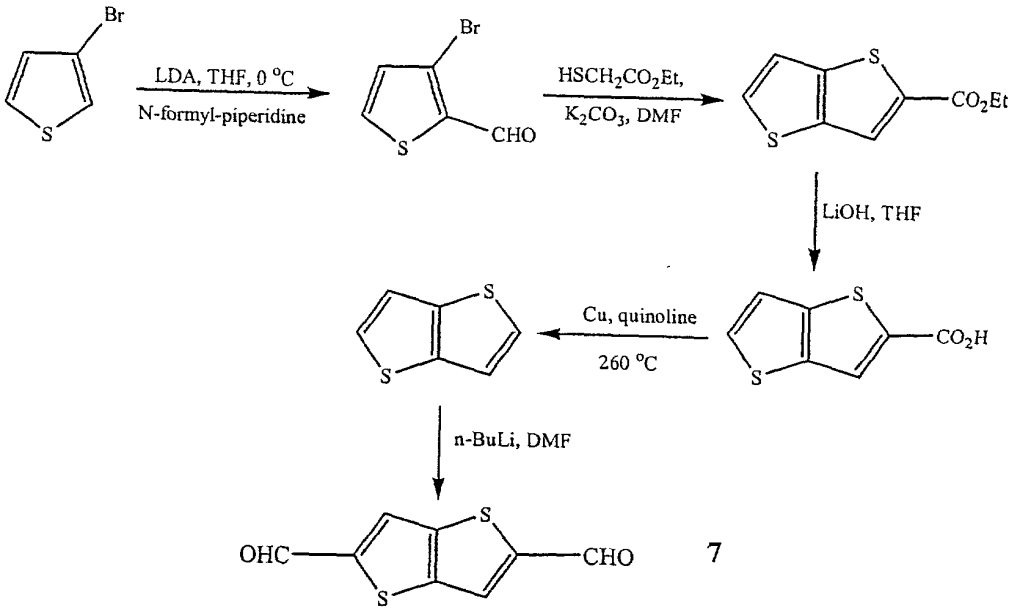


FIGURE 13

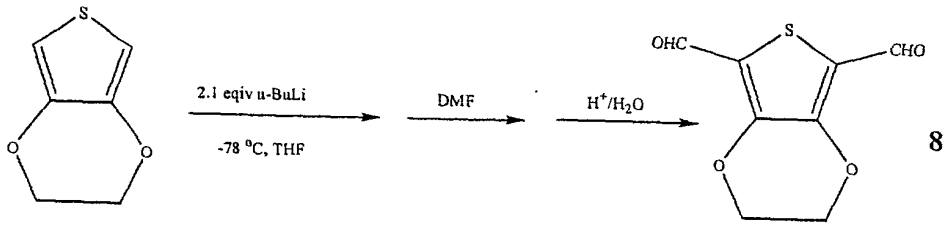


FIGURE 10

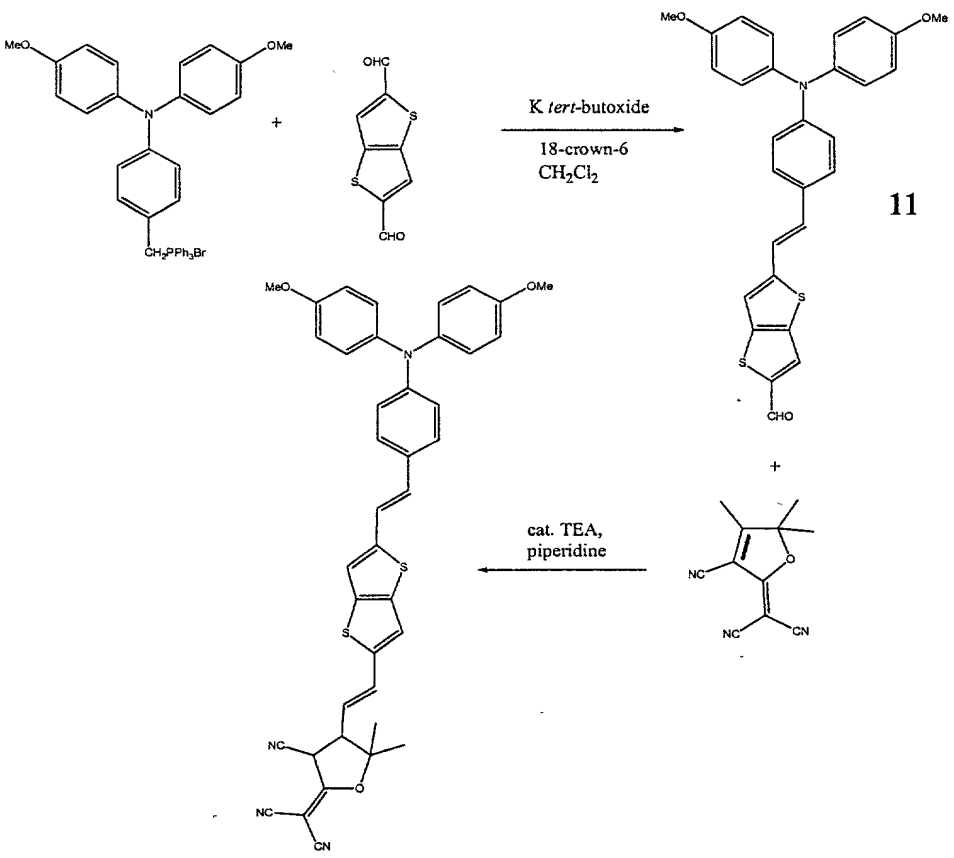

MeO
OMe
CH2PPh3Br
OHC
S
S
CHO
K tert-butoxide
18-crown-6
CH2Cl2
11
cat. TEA,
piperidine
NC
CN
O

FIGURE 12

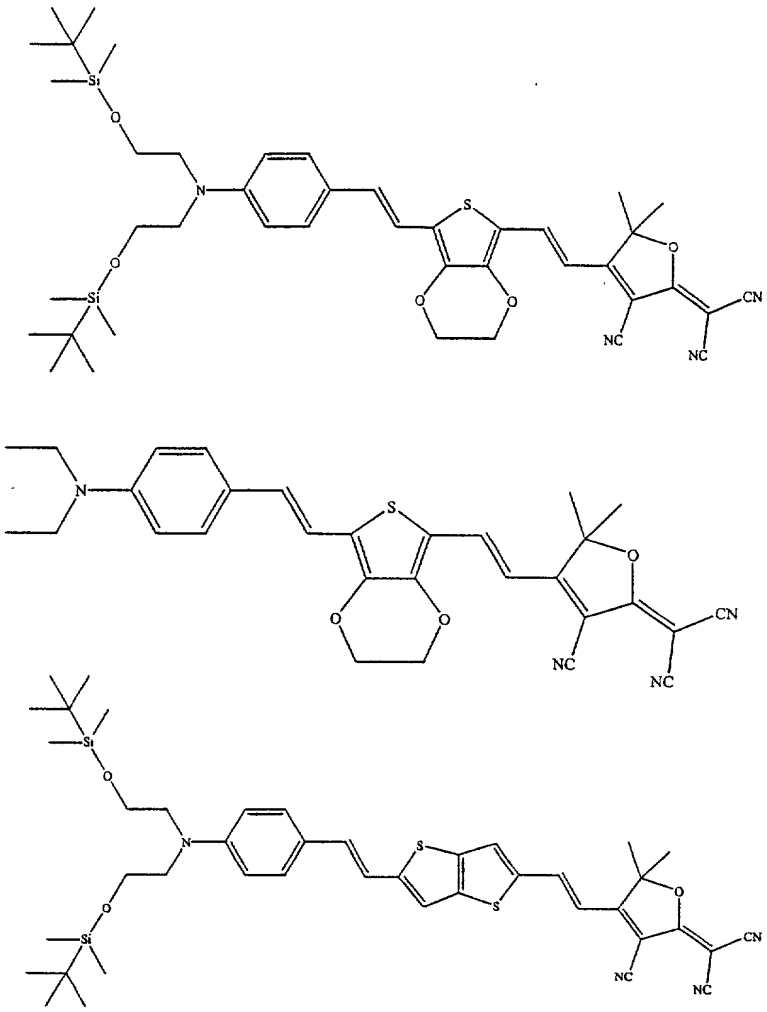


FIGURE 14

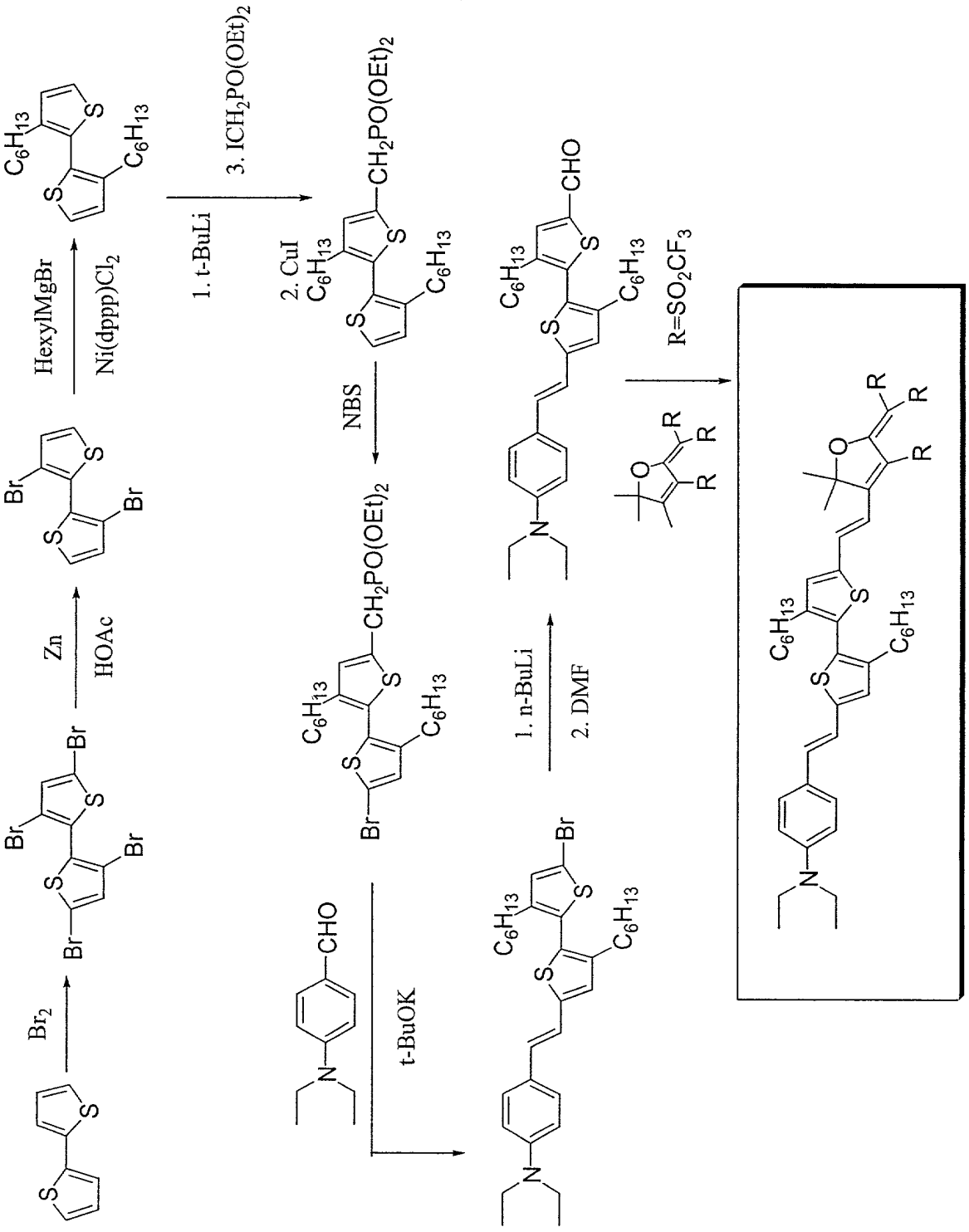

Br2
Zn
HOAc
HexylMgBr
Ni(dppp)Cl2
1. t-BuLi
3. ICH2PO(OEt)2
2. CuI
NBS
t-BuOK
1. n-BuLi
2. DMF
R=SO2CF3

FIGURE 15

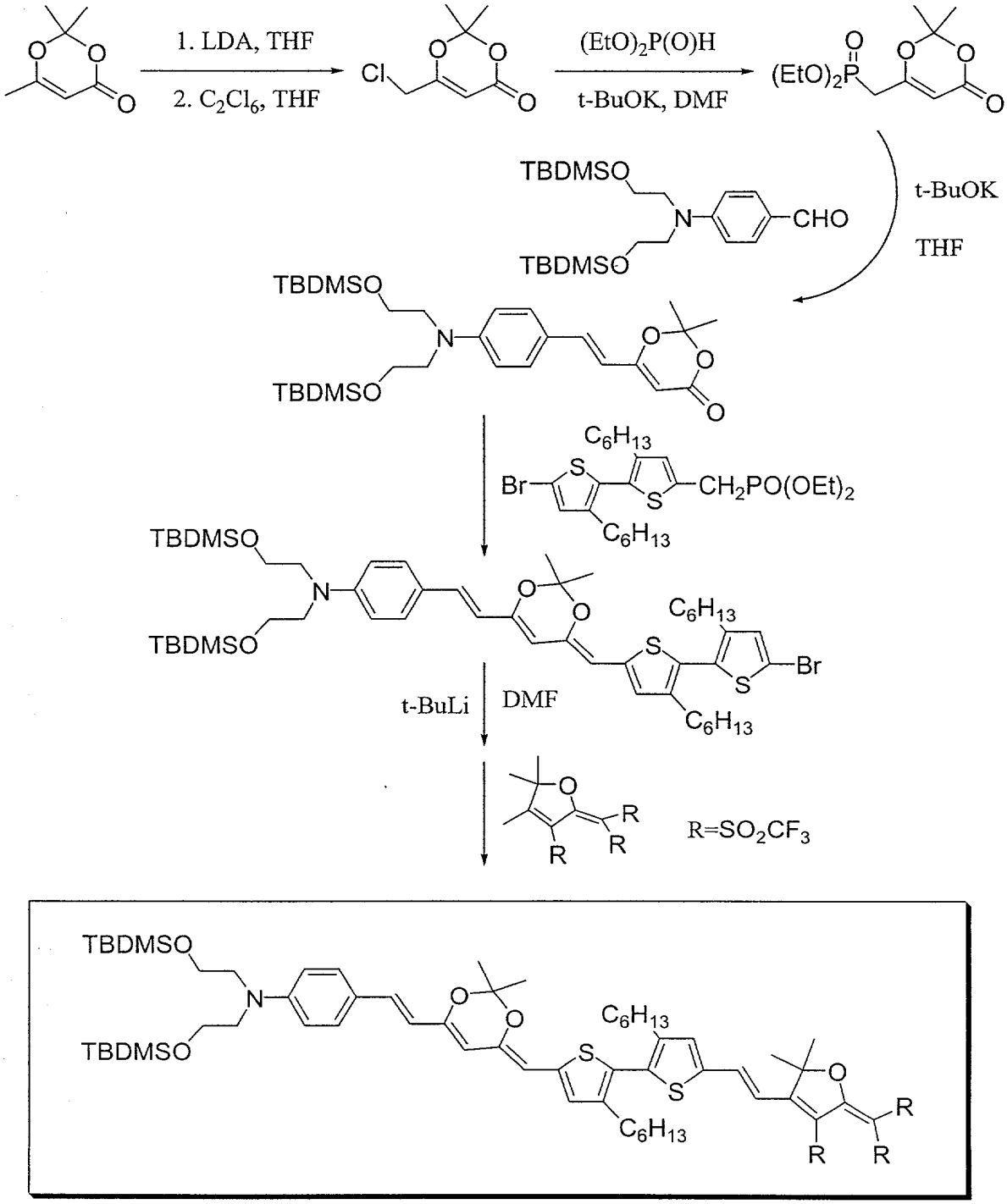

1. LDA, THF
2. C_2Cl_6, THF
$(EtO)_2P(O)H$
t-BuOK, DMF
t-BuOK
THF
TBDMSO
CHO
C_6H_{13}
$CH_2PO(OEt)_2$
t-BuLi
DMF
$R=SO_2CF_3$

FIGURE 17

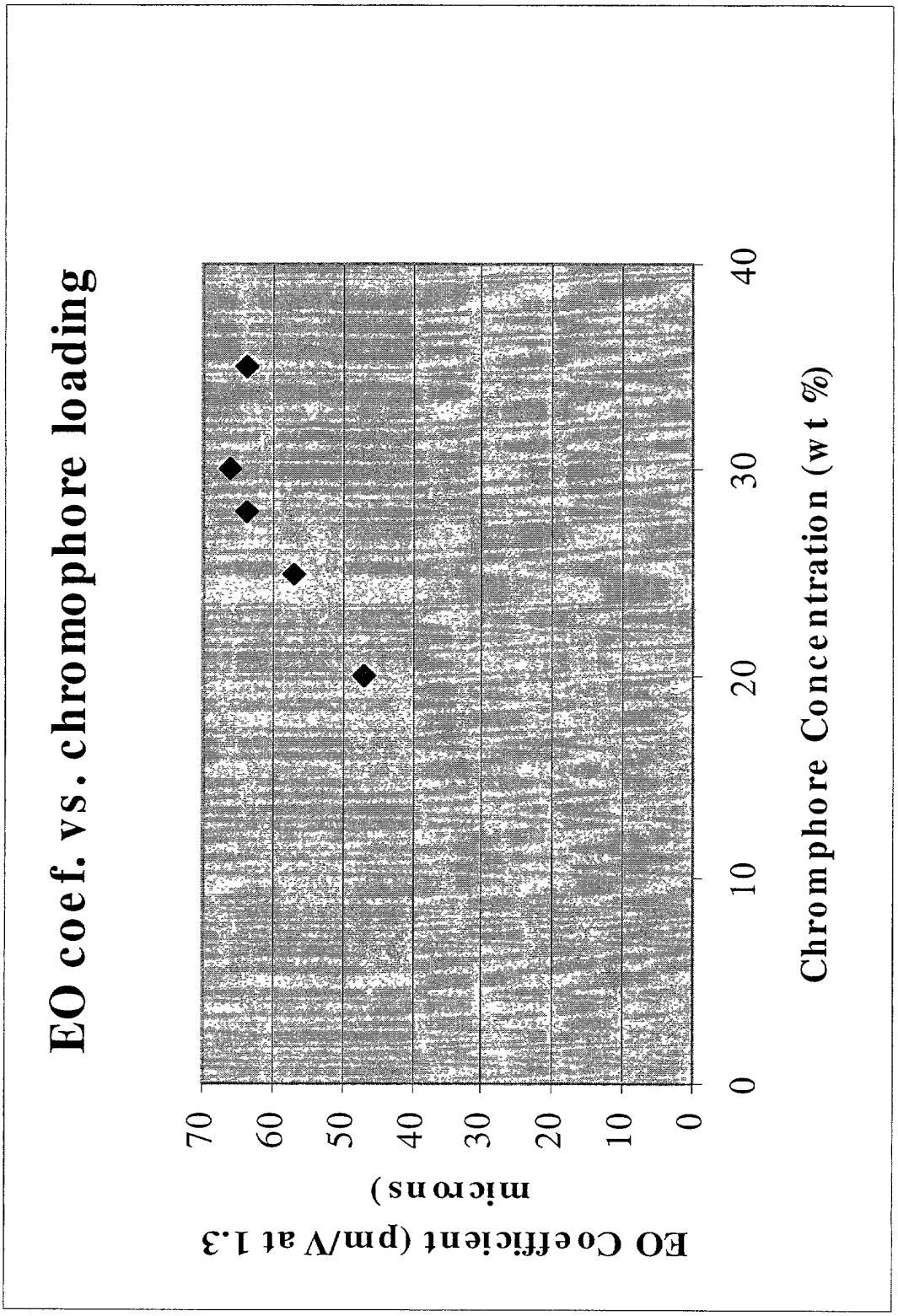

EO coef. vs. chromophore loading
EO Coefficient (pm/V at 1.3 microns)
70
60
50
40
30
20
10
0
0
10
20
30
40
Chromphore Concentration (wt %)

FIGURE 18

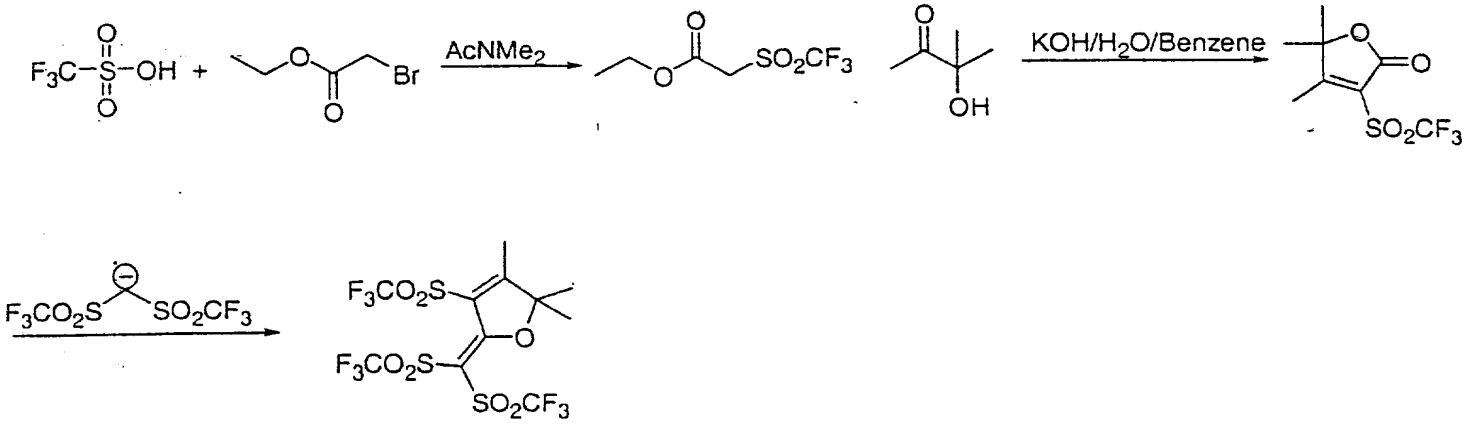


FIGURE 16

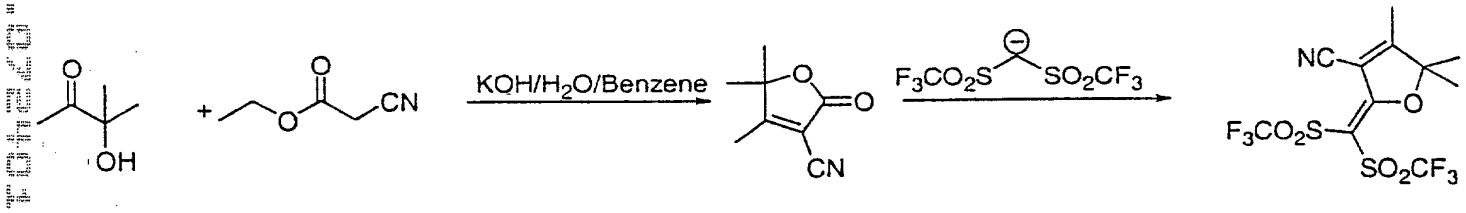


FIGURE 19

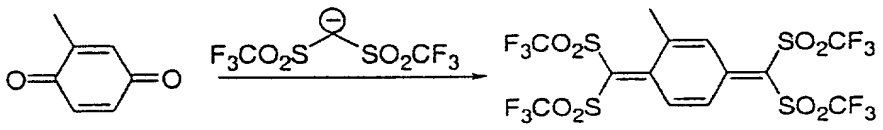


FIGURE 20

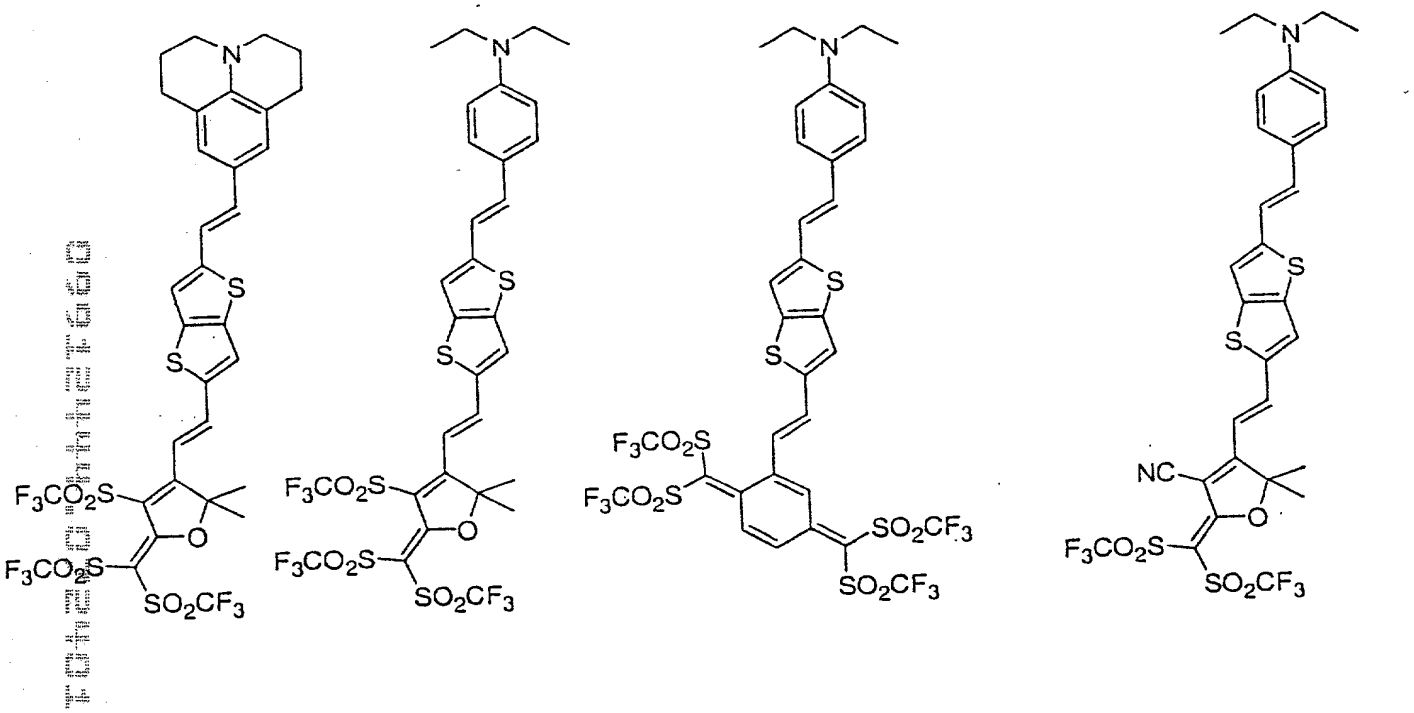


FIGURE 21

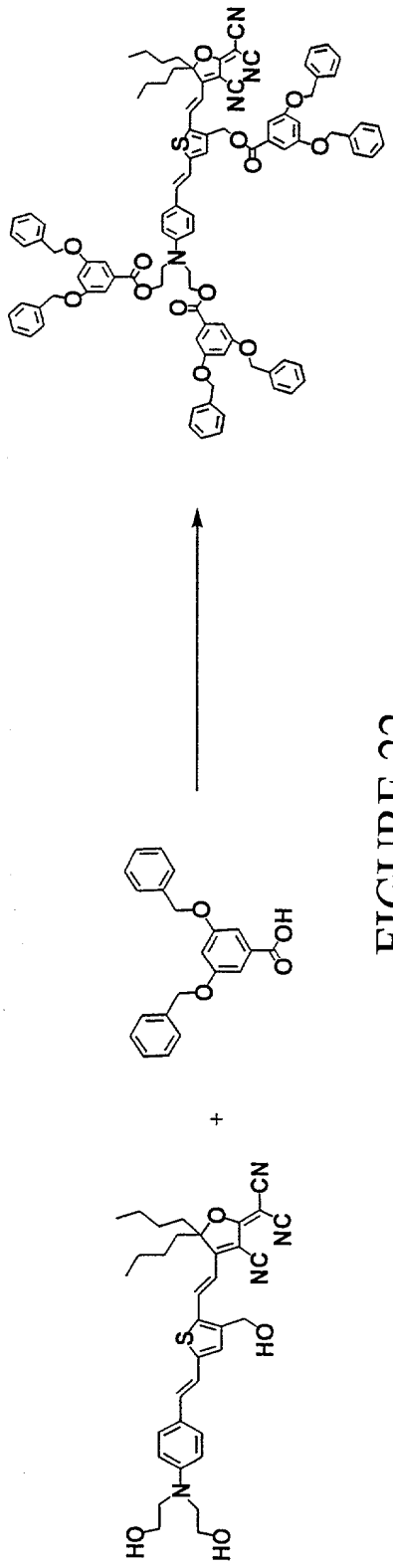


FIGURE 22

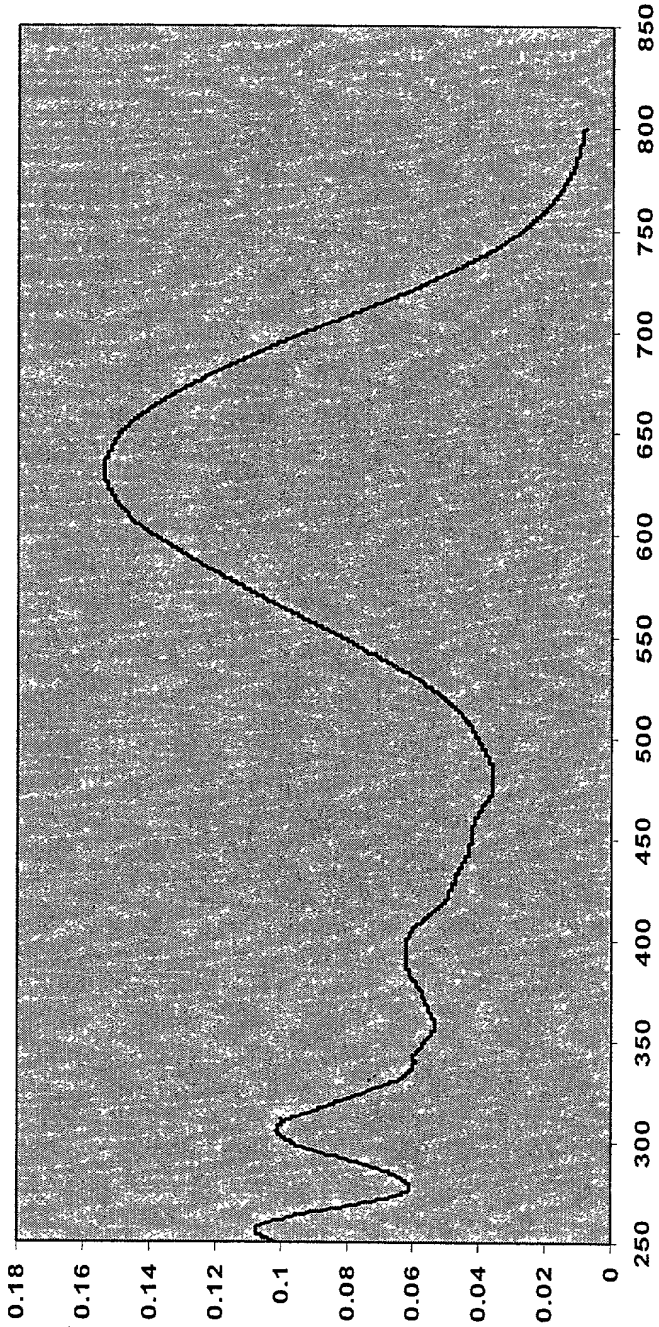


FIGURE 24

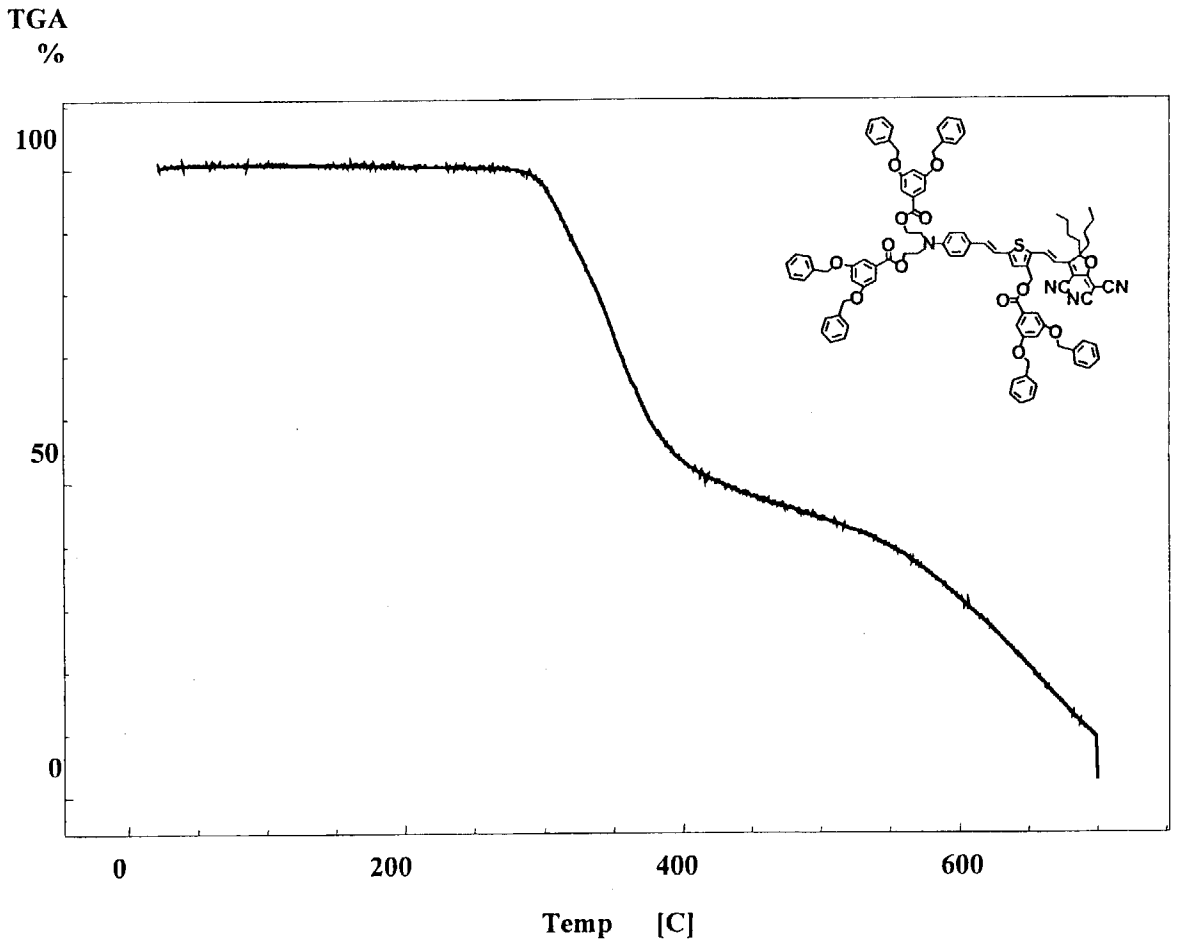


FIGURE 23

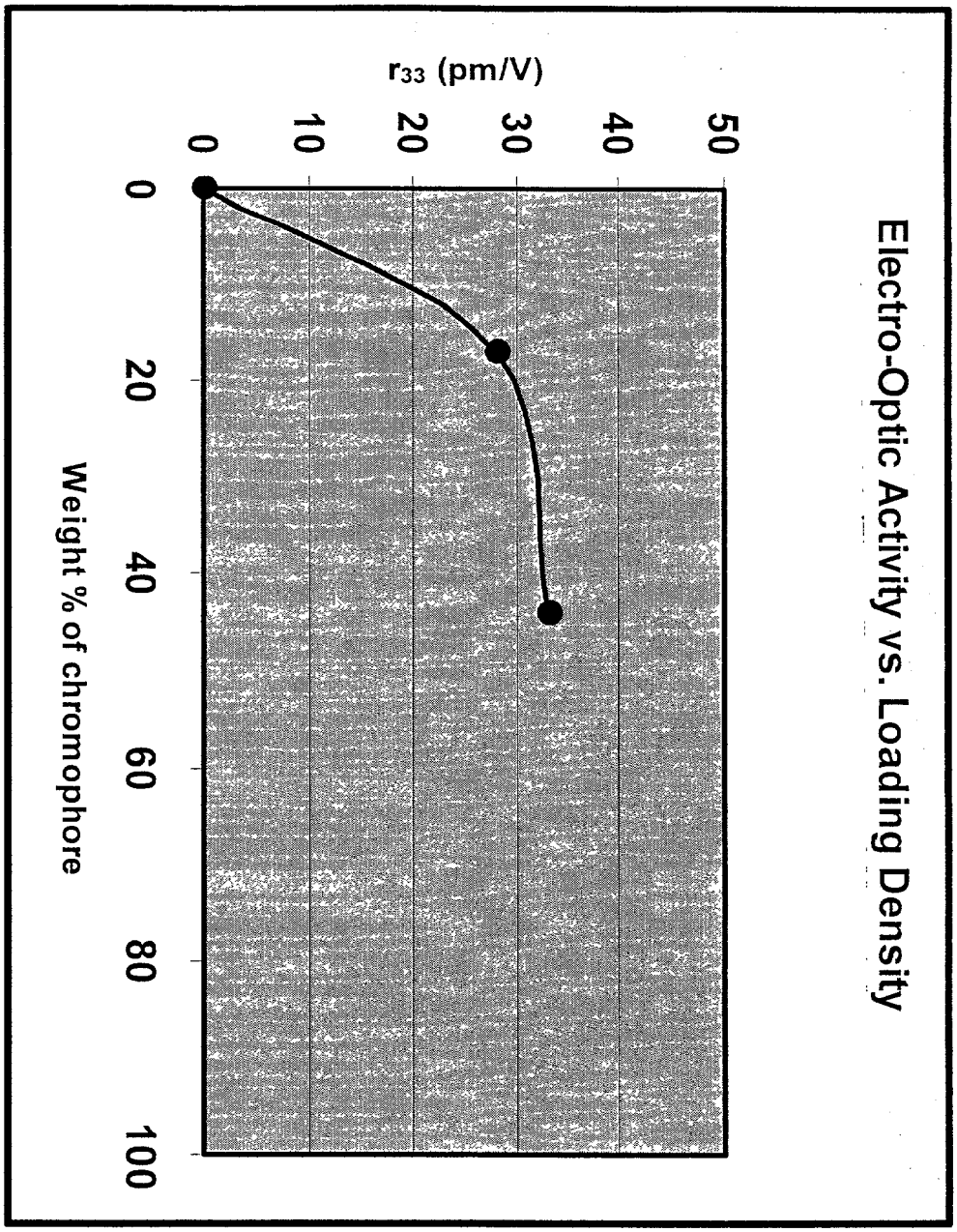

Electro-Optic Activity vs. Loading Density
r33 (pm/V)
0
10
20
30
40
50
Weight % of chromophore
0
20
40
60
80
100

FIGURE 25

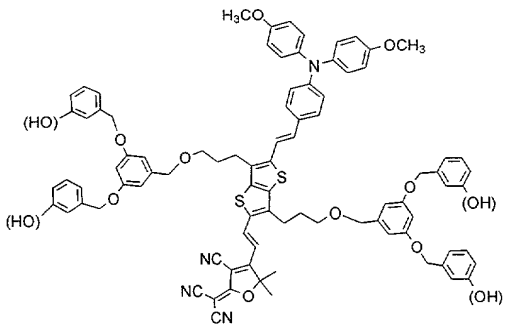


FIGURE 26

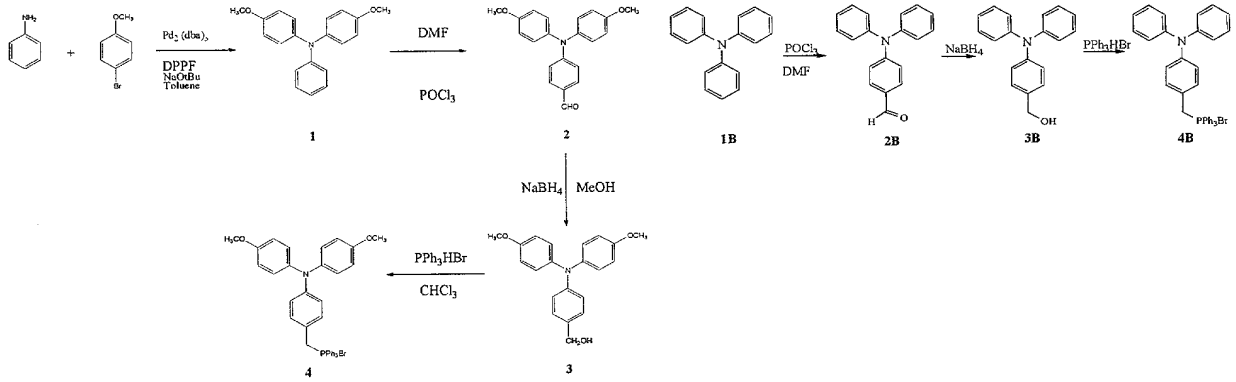

Pd2 (dba)3
DPPF
NaOtBu
Toluene
DMF
POCl3
NaBH4
MeOH
PPh3HBr
CHCl3
POCl3
DMF
NaBH4
PPh3HBr
1
2
1B
2B
3B
4B
3
4

FIGURE 27

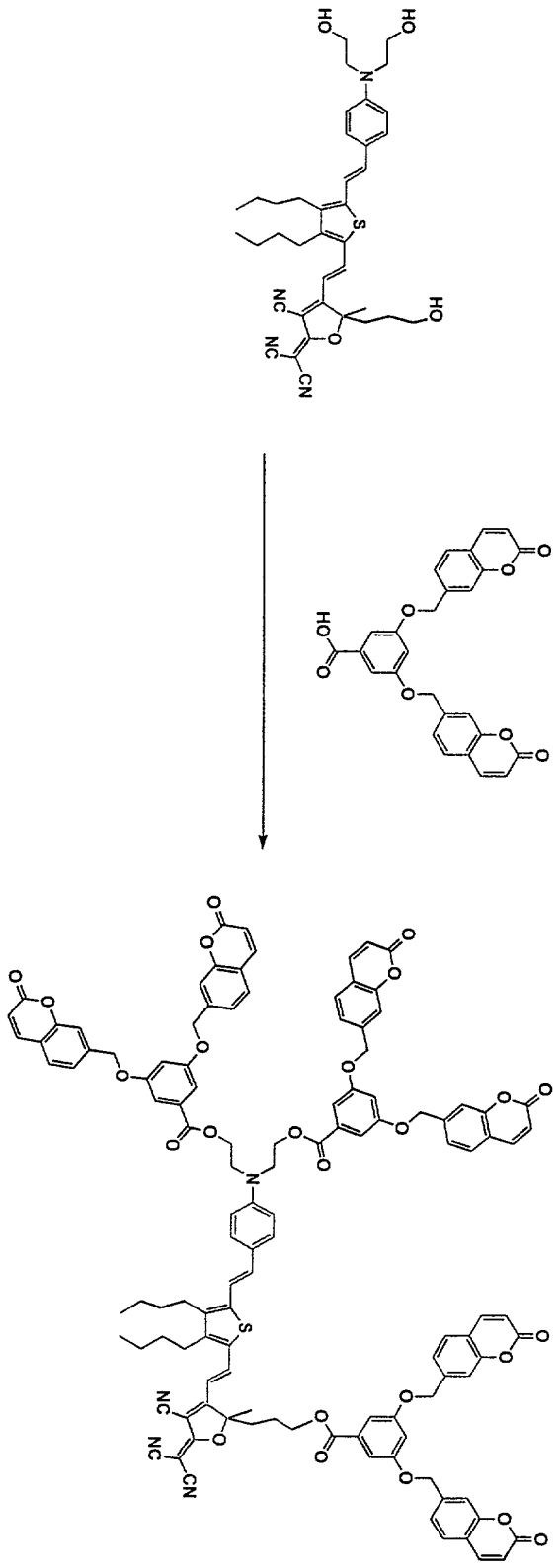


FIGURE 28

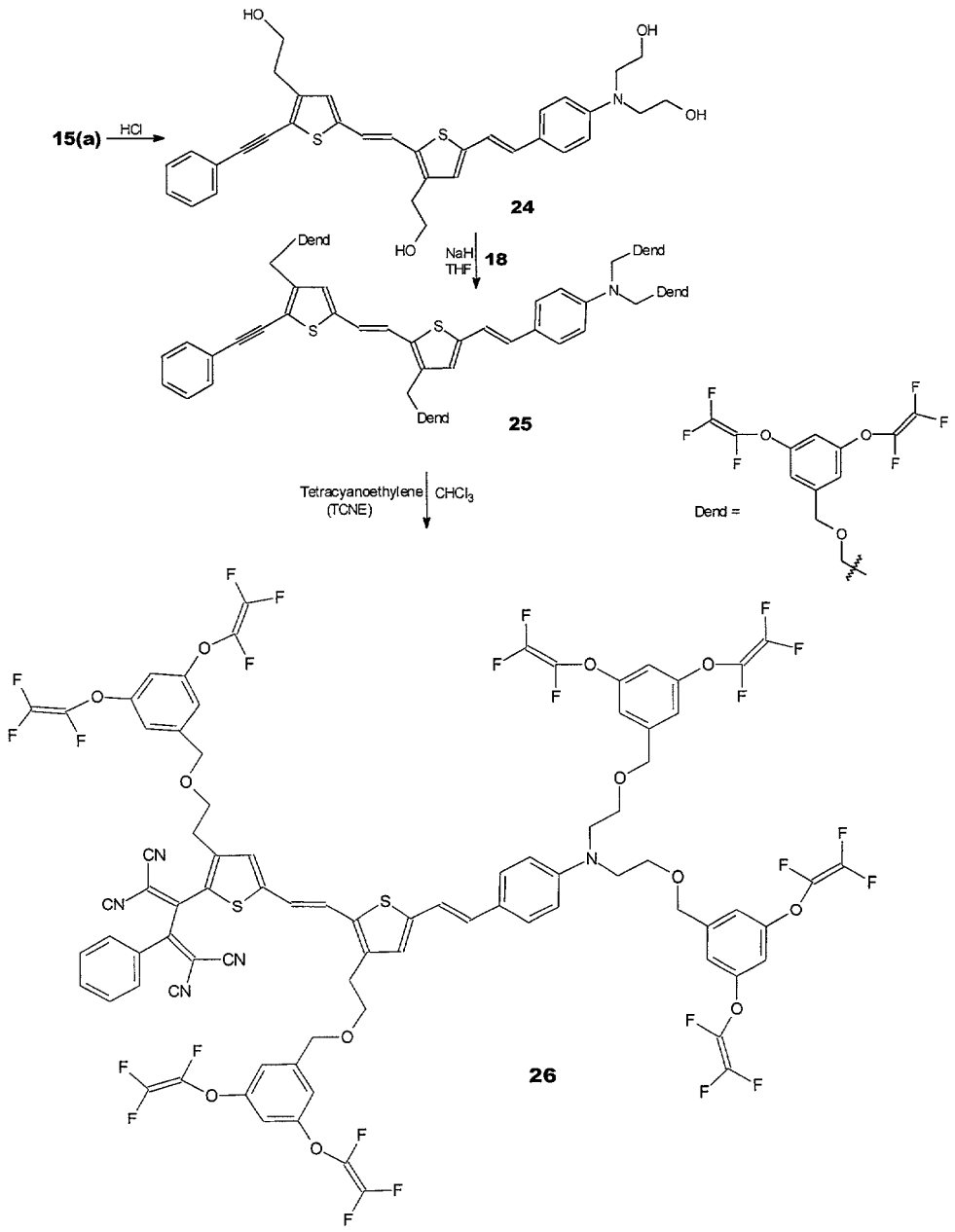
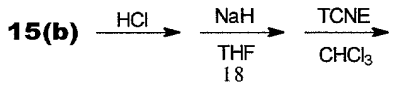

15(a)
HCl
24
NaH
THF
18
25
Tetracyanoethylene
(TCNE)
CHCl3
Dend =
26

FIGURE 29



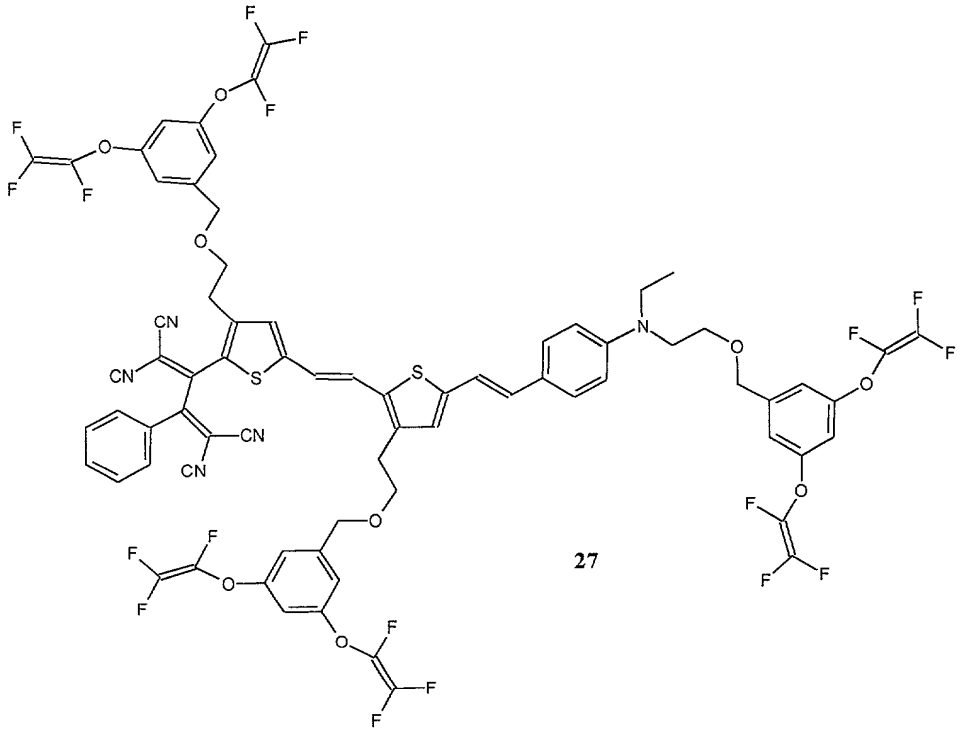
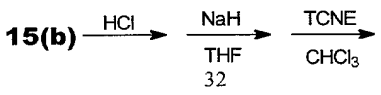
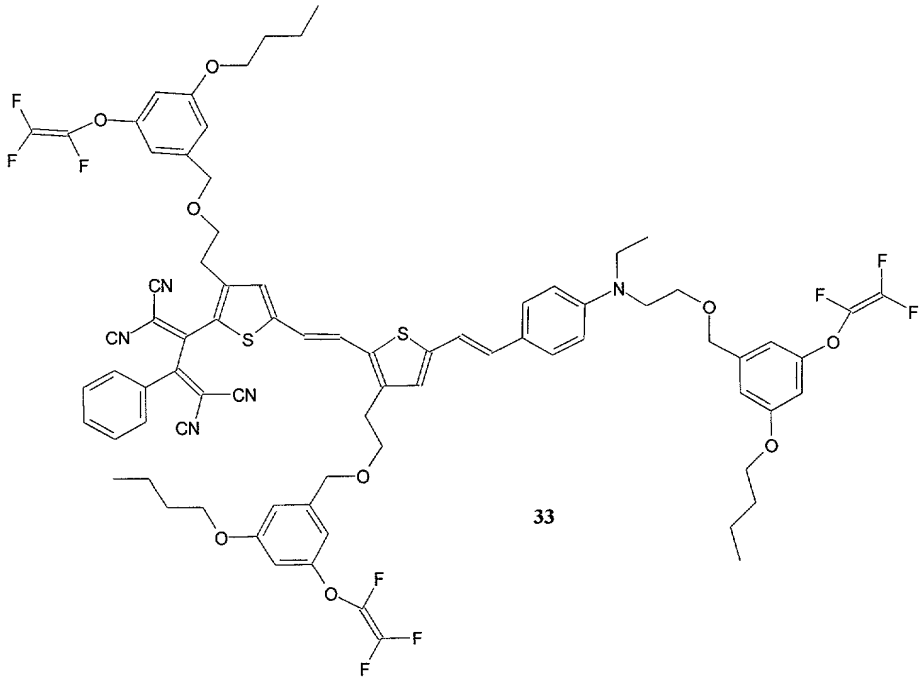


FIGURE 30



32



33

FIGURE 31

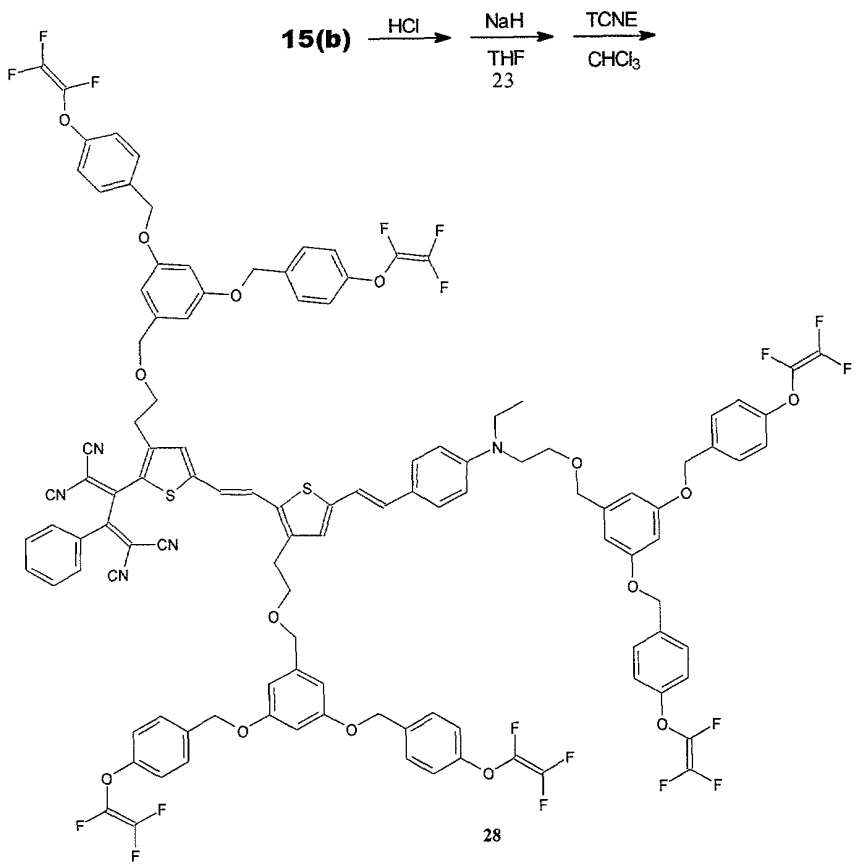


FIGURE 32

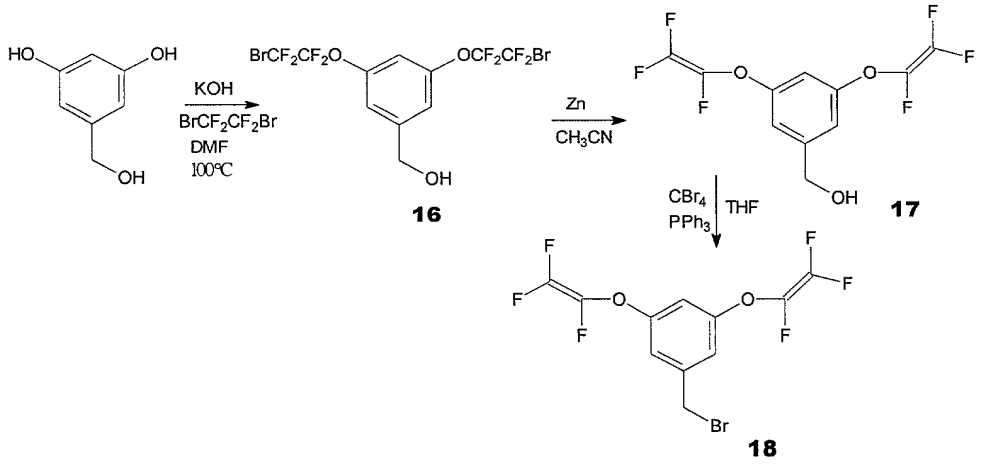

HO
OH
OH
KOH
$BrCF_2CF_2Br$
DMF
100°C
$BrCF_2CF_2O$
OCF_2CF_2Br
OH
16
Zn
CH_3CN
F
F
O
O
F
F
F
OH
17
CBr_4
PPh_3
THF
Br
18

FIGURE 33

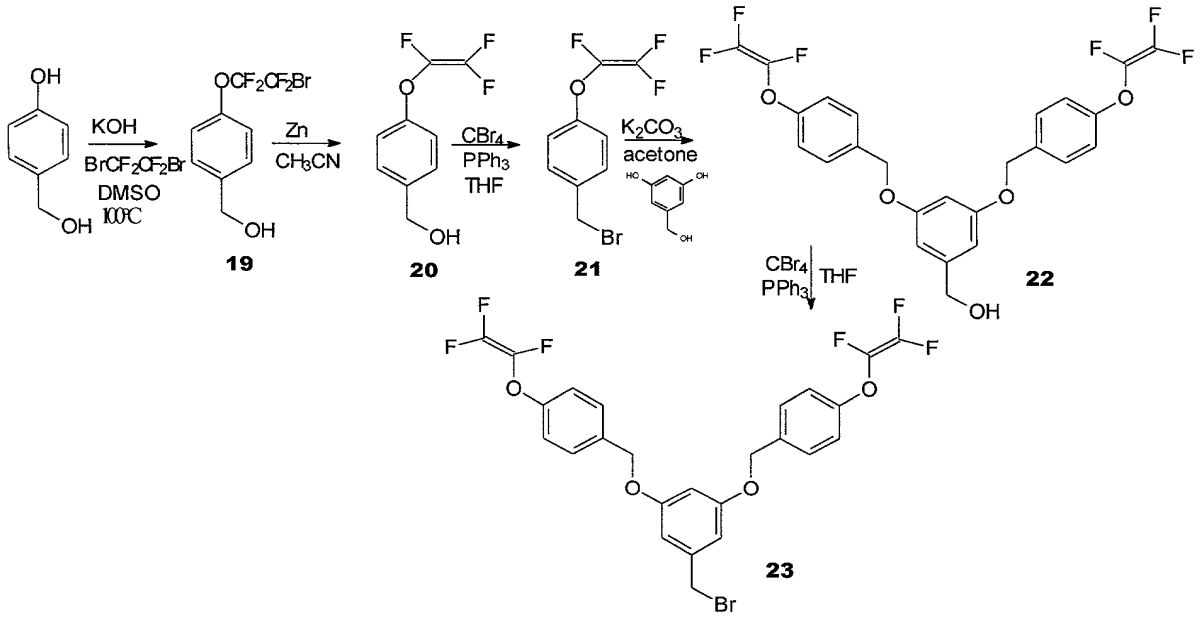

OH
KOH
BrCF2CF2Br
DMSO
100°C
OCF2CF2Br
OH
19
Zn
CH3CN
CBr4
PPh3
THF
20
K2CO3
acetone
21
22
23
Br

FIGURE 34

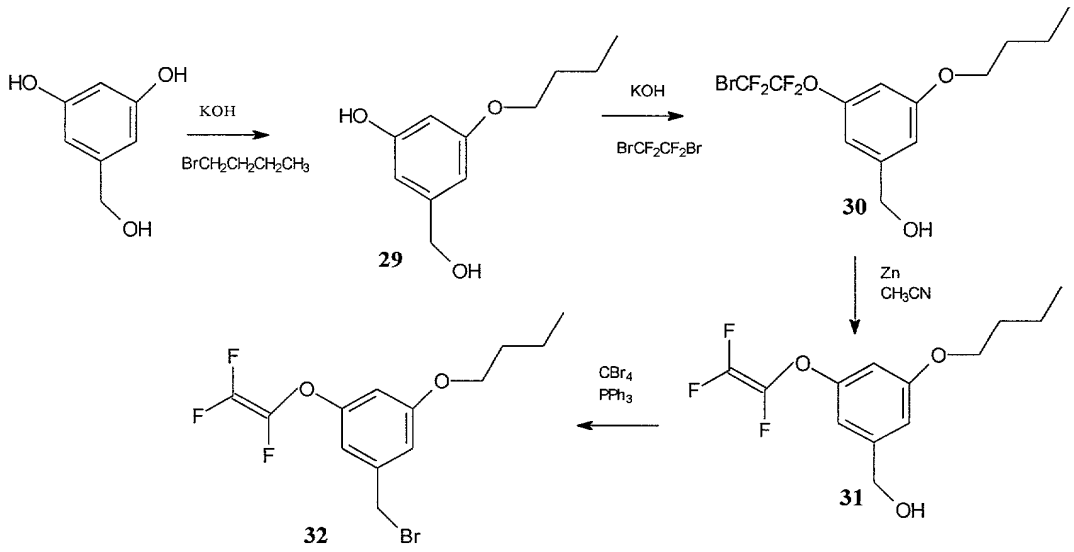

HO
OH
KOH
BrCH2CH2CH2CH3
HO
O
29
OH
KOH
BrCF2CF2Br
BrCF2CF2O
O
30
OH
Zn
CH3CN
F
F
O
O
31
OH
CBr4
PPh3
F
F
O
O
32
Br

FIGURE 35

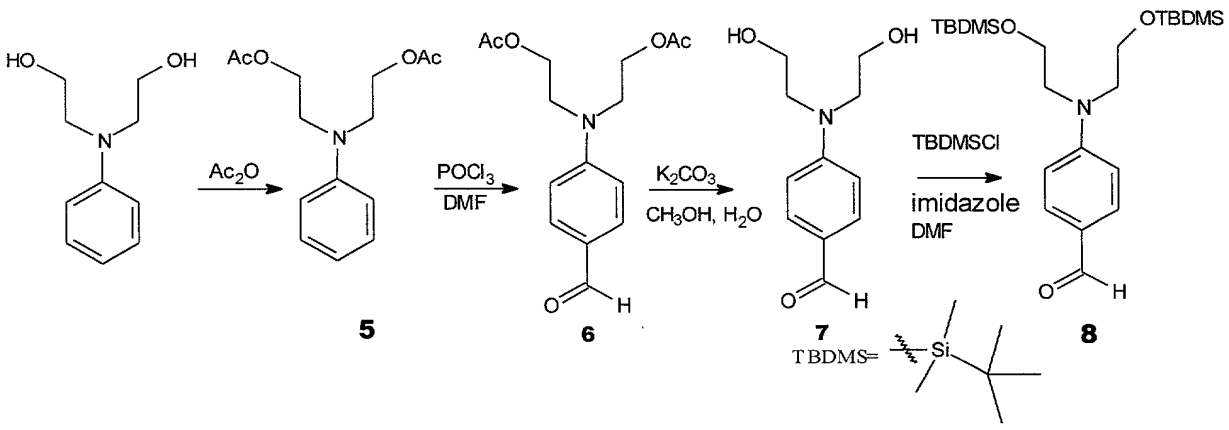


FIGURE 36

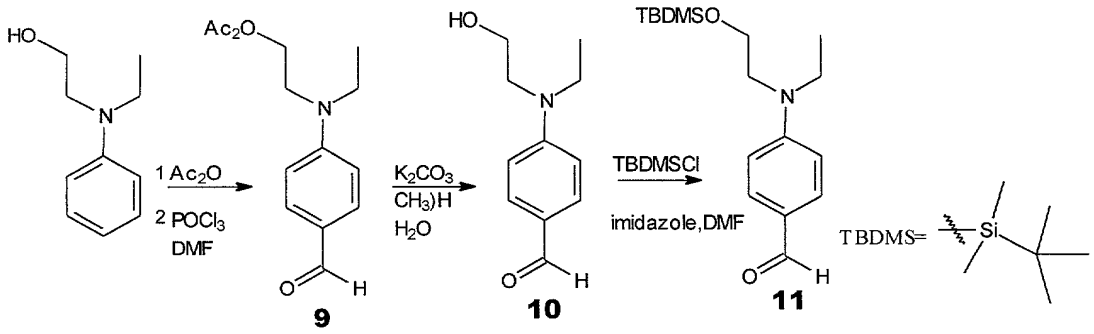
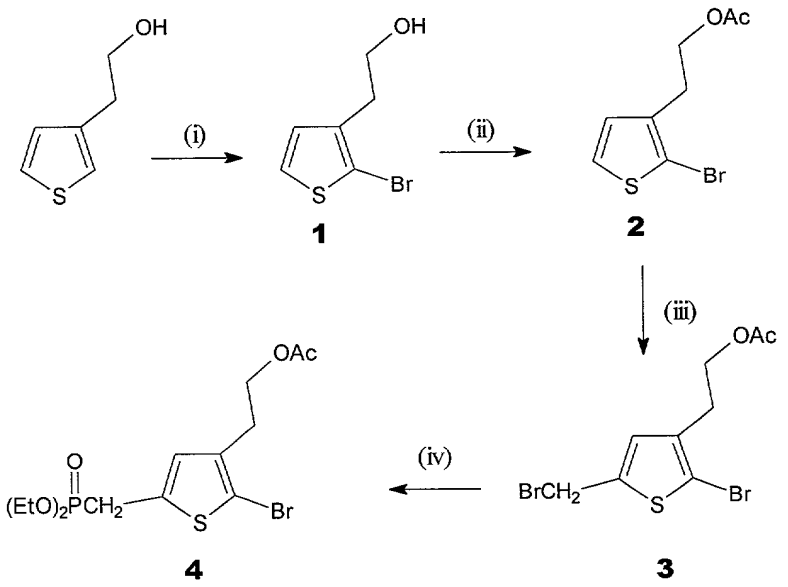
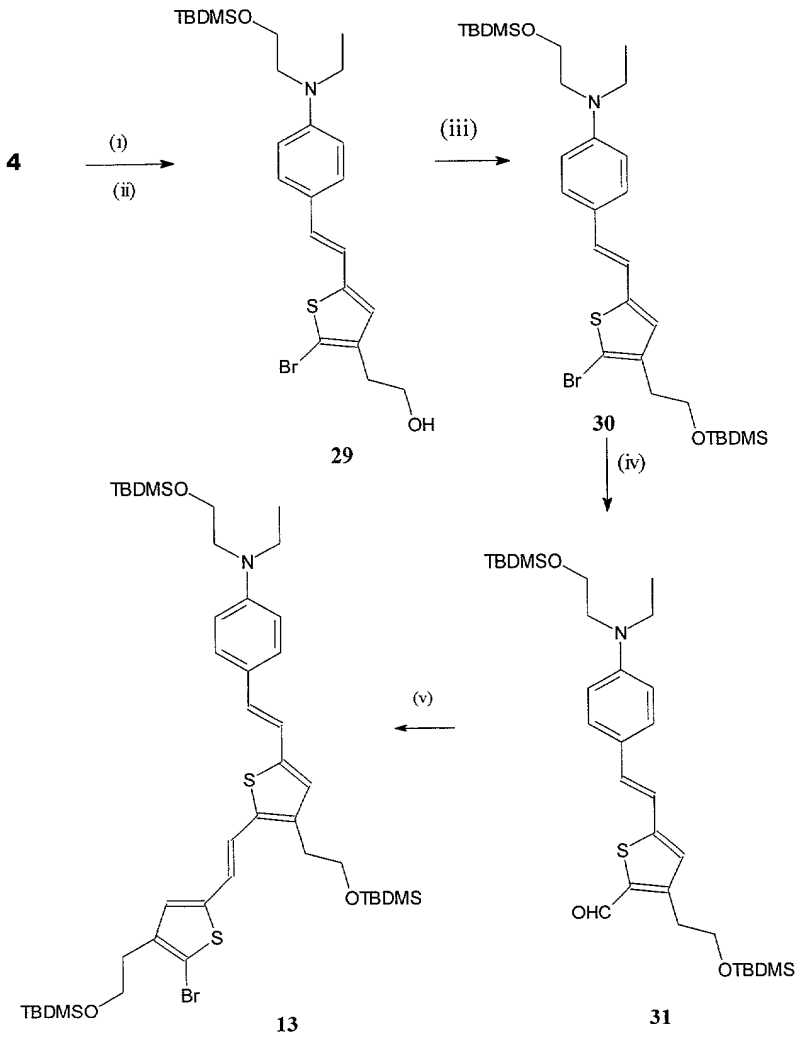


FIGURE 37



(i) NBS, DMF, RT;(ii) acetic anhydride, 60°C; (iii) $(CH_2O)n$, 45% HBr/HOAc, HOAc, 50°C; (iv) $P(OEt)_3$, DMF, 120°C.

FIGURE 38



(i) 11, KOtBu, THF, 0°C; (ii) K_2CO_3, CH_3OH, H_2O, RT; (iii) $(CH_3)_3CSi(CH_3)_2Cl$, imidazole, DMF, 50°C; (iv) a. nBu-Li, THF, -78°C; b. DMF, RT; (v) a. 4, KOtBu, THF, 0°C; b. K_2CO_3, CH_3OH, H_2O, RT; c. $(CH_3)_3CSi(CH_3)_2Cl$, imidazole, DMF, 50°C.

FIGURE 39

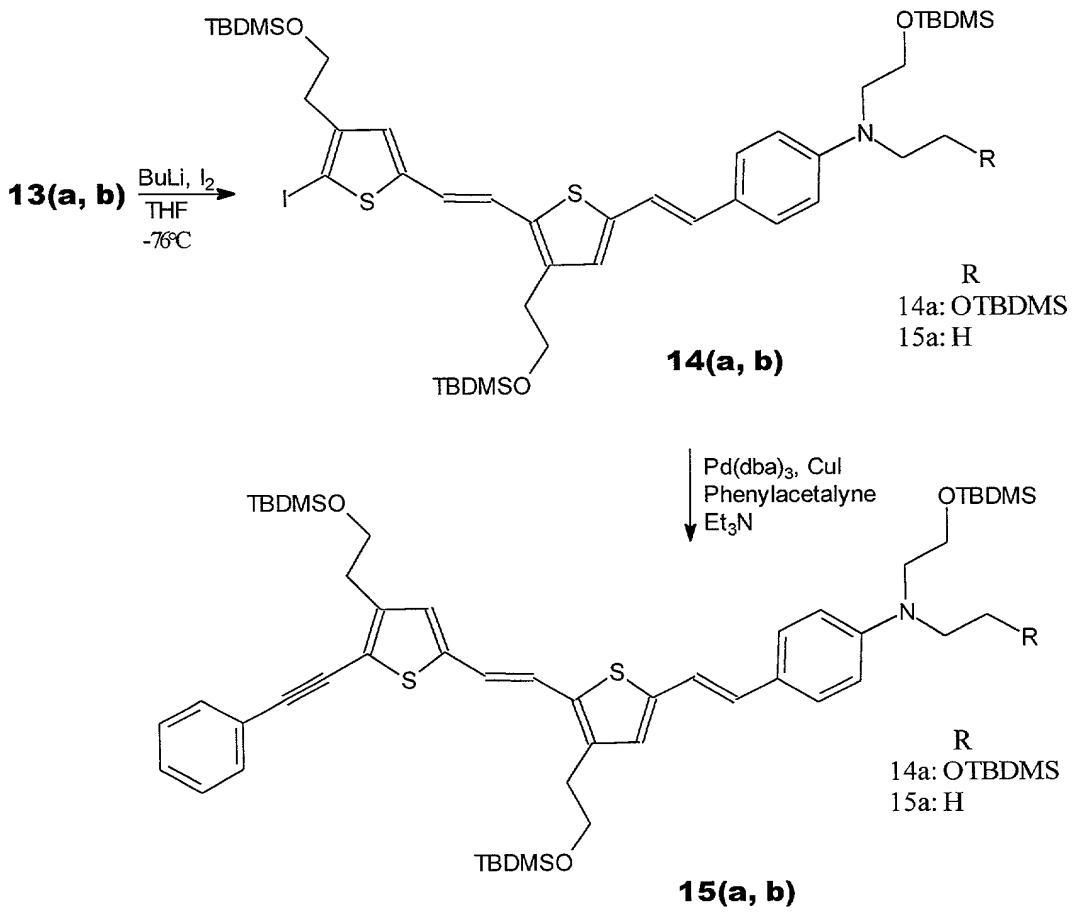
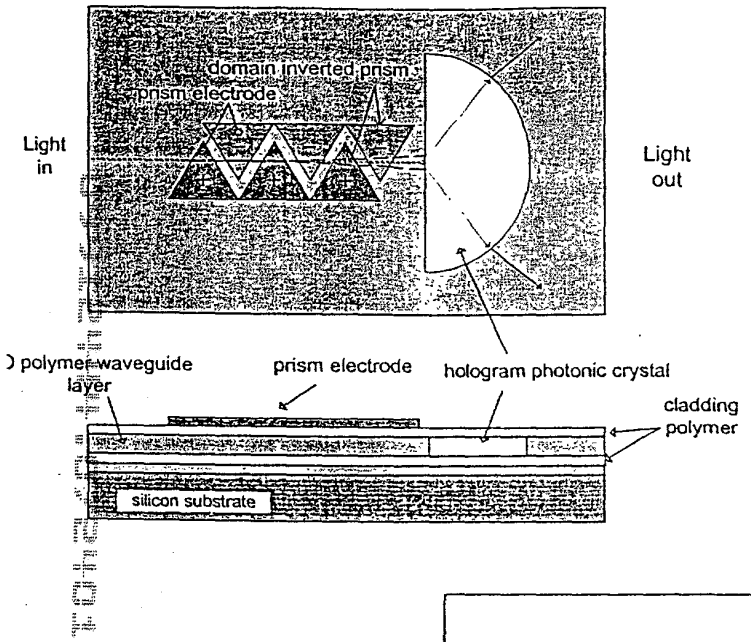


FIGURE 40

Large Angle Laser Beam Scanner



EO waveguide prism introduces a small deflection angle to initialize the beam scanning. The half-circle 2-D photonic crystal region is imbedded into the waveguide, so that the deflection angle is "amplified" as the light pass through the crystal region. 3D scanning can also be provided if a 3-D structure is built

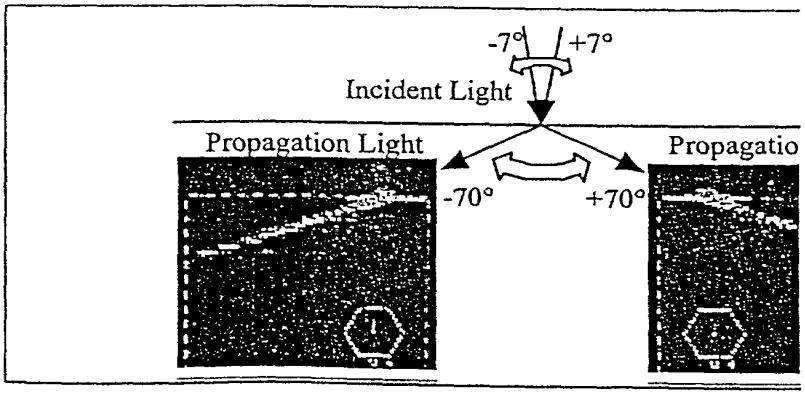
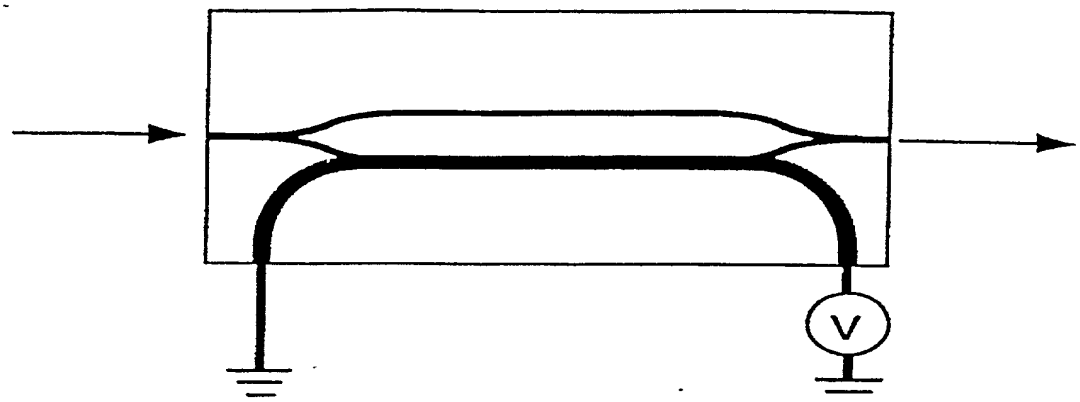
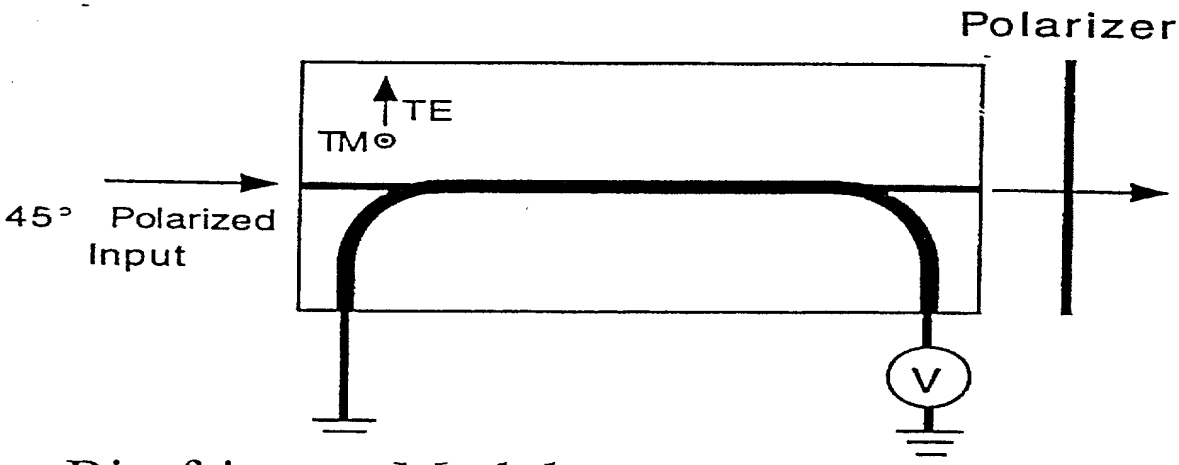


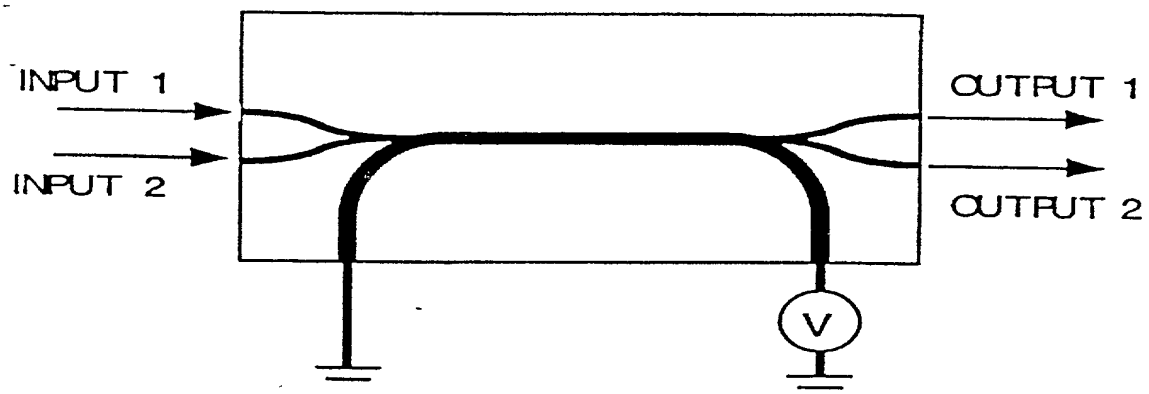
FIGURE 41



Mach Zehnder Modulator

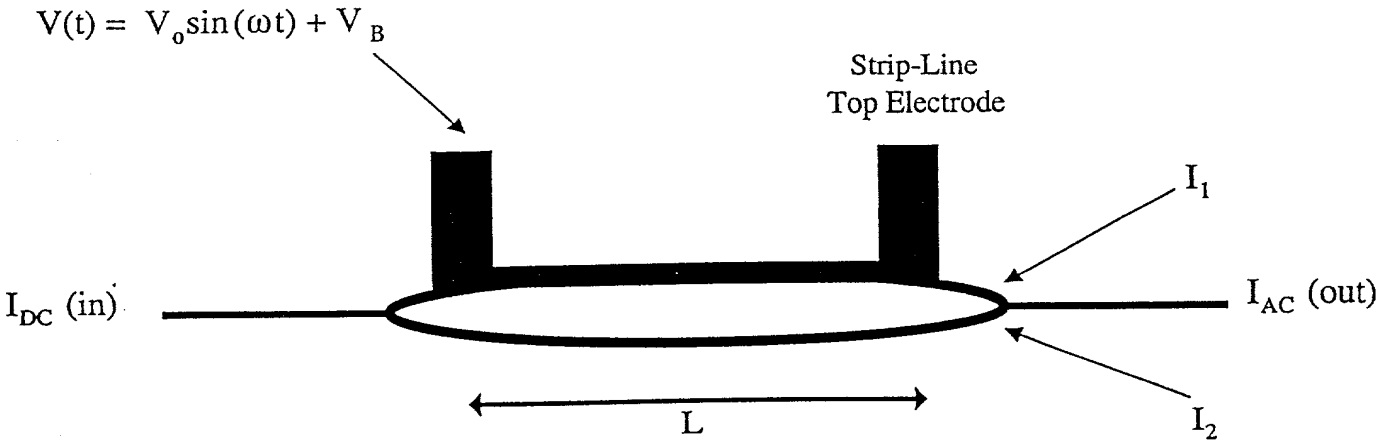


Birefringent Modulator



Directional Coupler

FIGURE 42



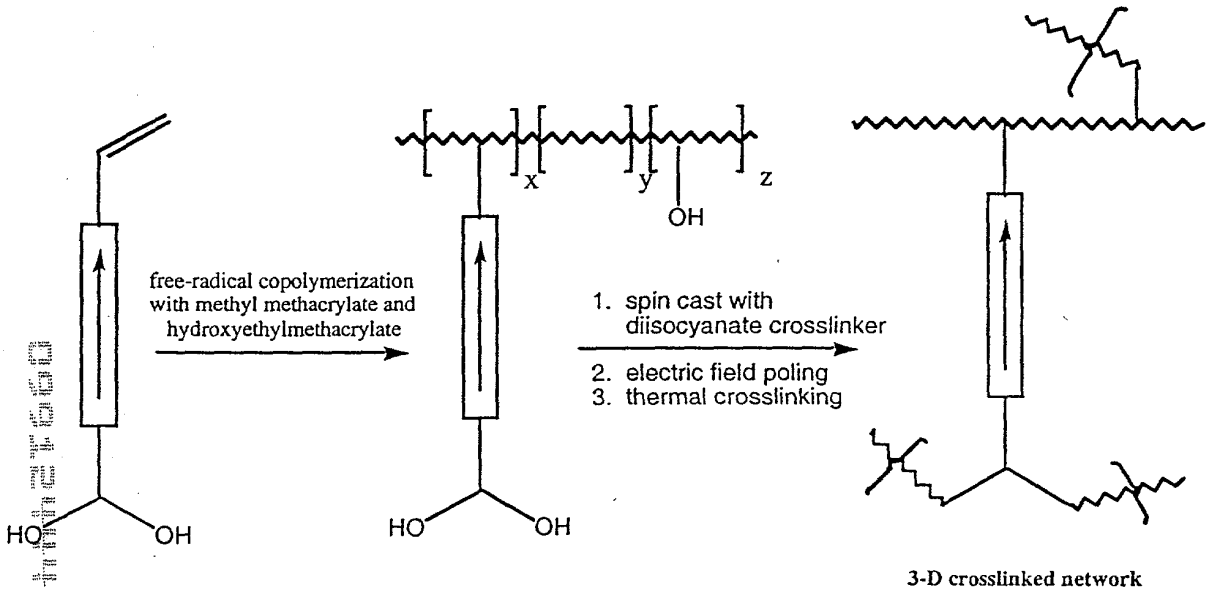
$$I_{AC}\ (out) = I_1 + I_2 + 2(I_1 I_2)^{1/2} \sin(\rho V_o \sin(\omega t))$$

$$\rho = 2\pi r_{33} n^3 L V_o / T\lambda$$

Comparison of key features of simple devices

	Mach Zehnder Interferometer	Birefringent Modulator	Directional Coupler
r_{eff}	r_{33}	r_{33}-r_{13}	r_{33}
V_π	$V_{\pi MZ}$	1.5 $V_{\pi MZ}$	1.73 $V_{\pi MZ}$
Mod. Power	P_{MZ}	2.75 P_{MZ}	3 P_{MZ}

FIGURE 43


HO
OH
free-radical copolymerization
with methyl methacrylate and
hydroxyethylmethacrylate
x
y
z
OH
HO
OH
1. spin cast with
diisocyanate crosslinker
2. electric field poling
3. thermal crosslinking
3-D crosslinked network

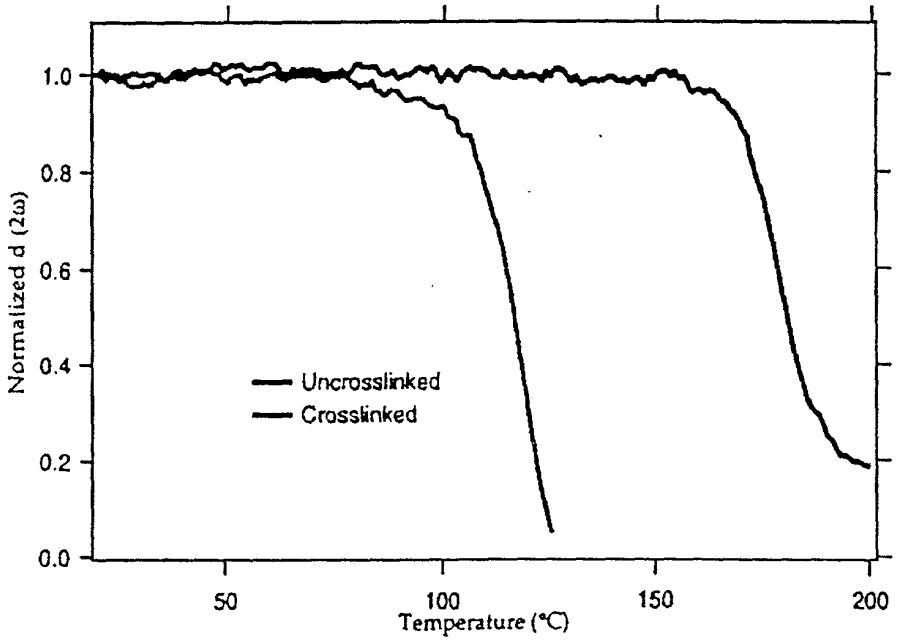

Normalized d (2ω)
1.0
0.8
0.6
0.4
0.2
0.0
Uncrosslinked
Crosslinked
50
100
150
200
Temperature (°C)

FIGURE 44

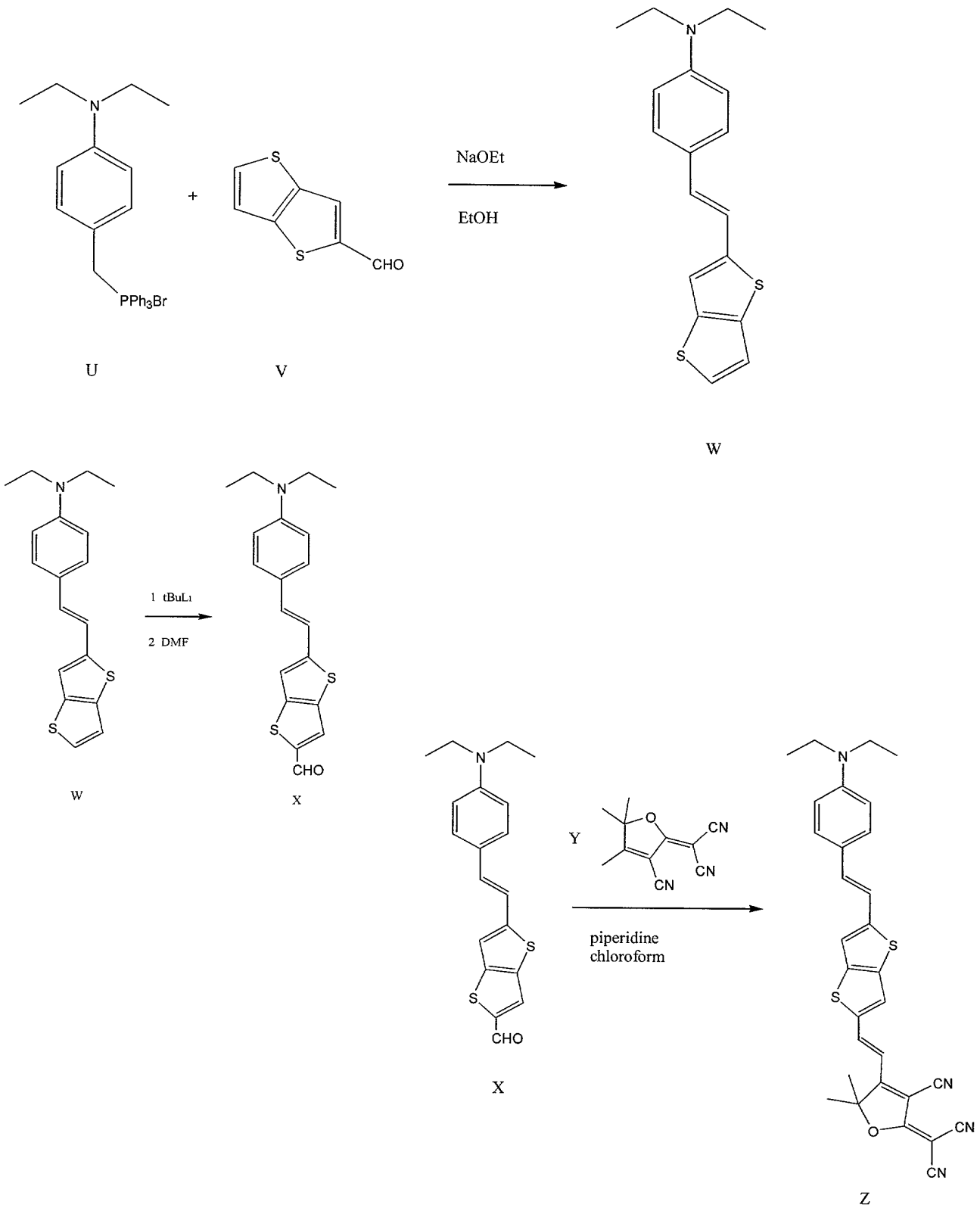

N
PPh3Br
S
CHO
NaOEt
EtOH
U
V
W
1 tBuLi
2 DMF
W
X
Y
CN
O
piperidine
chloroform
X
Z

FIGURE 45

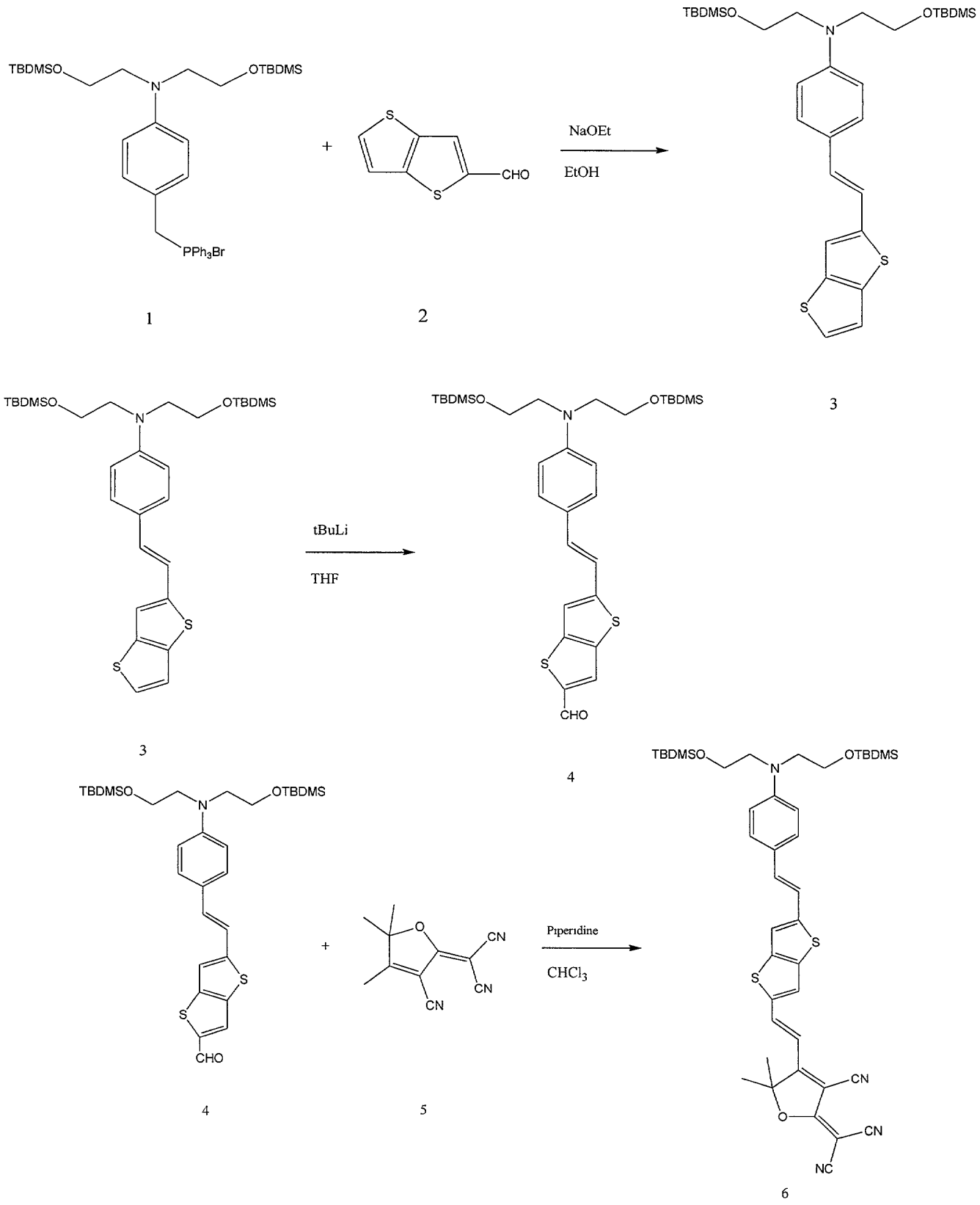

TBDMSO
OTBDMS
N
PPh3Br
1
+
S
CHO
2
NaOEt
EtOH
3
tBuLi
THF
4
Piperidine
CHCl3
CN
NC
O
5
6

FIGURE 46

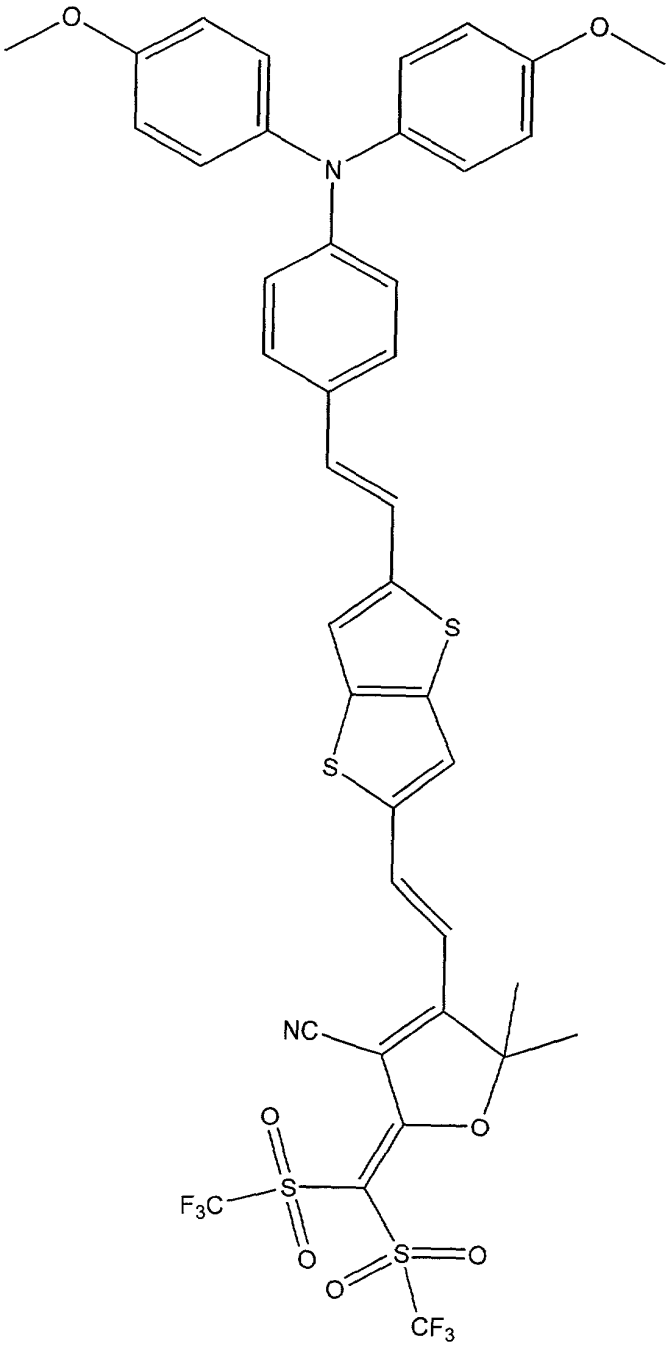
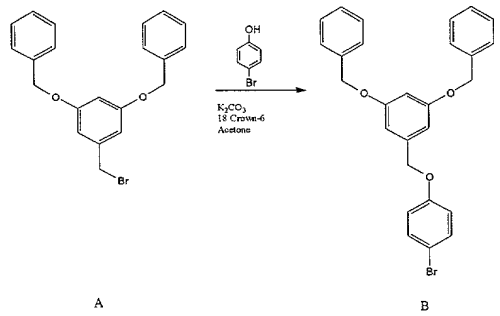
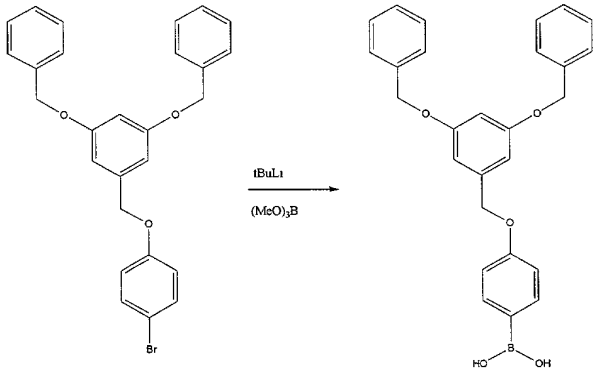


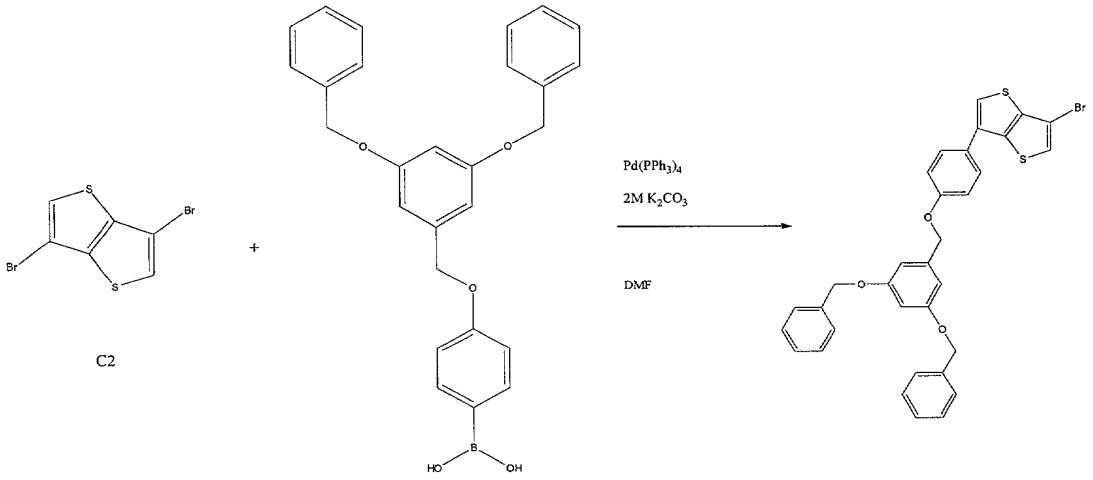
FIGURE 47



A B



B C



C2 C D

FIGURE 48